Integrated Circuit Systems, Inc.

ICS9248-55

Pentium/Pro/II™ System Clock Chip

General Description

The **ICS9248-55** is a Clock Synthesizer chip for Pentium and PentiumPro CPU based Desktop/Notebook systems that will provide all necessary clock timing.

Features include four CPU and eight PCI clocks. Three reference outputs are available equal to the crystal frequency. Additionally, the device meets the Pentium power-up stabilization requirement, assuring that CPU and PCI clocks are stable within 2ms after power-up.

PD# pin enables low power mode by stopping crystal OSC and PLL stages. Other power management features include CPU_STOP#, which stops CPU (0:3) clocks, and PCI_STOP#, which stops PCICLK (0:6) clocks.

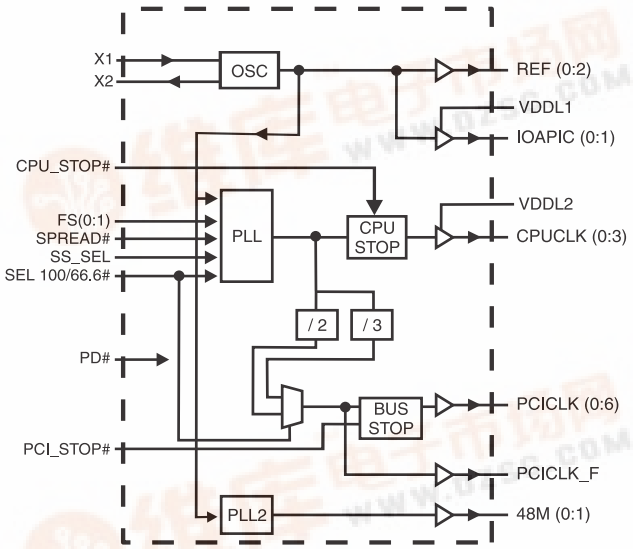
High drive CPUCLK outputs typically provide greater than 1 V/ns slew rate into 20pF loads. PCICLK outputs typically provide better than 1V/ns slew rate into 30pF loads while maintaining 50±5% duty cycle. The REF clock outputs typically provide better than 0.5V/ns slew rates.

The **ICS9248-55** accepts a 14.318MHz reference crystal or clock as its input and runs on a 3.3V core supply.

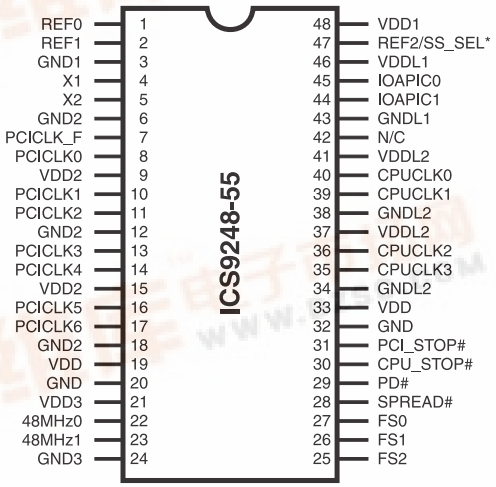
Features

- Generates system clocks for CPU, IOAPIC, PCI, plus 14.314 MHz REF (0:2), USB, and Super I/O
- Supports single or dual processor systems
- Supports Spread Spectrum modulation for CPU & PCI clocks, down spread -0.5%
- Skew from CPU (earlier) to PCI clock (rising edges for 100/33.3MHz) 1.5 to 4ns
- Two fixed outputs at 48MHz.
- Separate 2.5V and 3.3V supply pins
- 2.5V or 3.3V output: CPU, IOAPIC
- 3.3V outputs: PCI, REF, 48MHz
- No power supply sequence requirements
- Uses external 14.318MHz crystal, no external load cap required for C_L=18pF crystal
- 48 pin 300 mil SSOP

Block Diagram



Pin Configuration



48-Pin SSOP

* Internal Pull-down Resistor of 240K to GND. on indicated inputs

Power Groups

VDD = Supply for PLL core
VDD1 = REF (0:2), X1, X2
VDD2 = PCICLK_F, PCICLK (0:6)
VDD3 = 48MHz0, 48MHz1
VDDL1 = IOAPIC (0:1)
VDDL2 = CPUCLK (0:3)

Ground Groups

GND = Ground for PLL core
GND1 = REF (0:2), X1, X2
GND2 = PCICLK_F, PCICLK (0:6)
GND3 = 48MHz0, 48MHz1
GNDL1 = IOAPIC (0:1)
GNDL2 = CPUCLK (0:3)

Pentium is a trademark on Intel Corporation.

Pin Descriptions

PIN NUMBER	PIN NAME	TYPE	DESCRIPTION
1, 2	REF0, REF1	OUT	14.318MHz clock output
3	GND1	PWR	Ground for REF outputs
4	X1	IN	XTAL_IN 14.318MHz Crystal input, has internal 33pF load cap and feed back resistor from X2
5	X2	OUT	XTAL_OUT Crystal output, has internal load cap 33pF
6, 12, 18	GND2	PWR	Ground for PCI outputs
7	PCICLK_F	OUT	Free Running PCI output
8, 10, 11, 13, 14, 16, 17	PCICLK (0:6)	OUT	PCI clock outputs. TTL compatible 3.3V
9, 15	VDD2	PWR	Power for PCICLK outputs, nominally 3.3V
19, 33	VDD	PWR	Isolated power for core, nominally 3.3V
20, 32	GND	PWR	Isolated ground for core
21	VDD3	PWR	Power for 48MHz outputs, nominally 3.3V
22, 23	48MHz (0:1)	OUT	48MHz outputs
24	GND3	PWR	Ground for 48MHz outputs
25, 26, 27	FS (0:2)	IN	Frequency Select pins
28	SPREAD#	IN	Enables Spread Spectrum feature when LOW
29	PD#	IN	Powers down chip, active low
30	CPU_STOP#	IN	Halts CPU clocks at logic "0" level when low
31	PCI_STOP#	IN	Halts PCI Bus at logic "0" level when low
37, 41	VDDL2	PWR	Power for CPU outputs, nominally 2.5V
34, 38	GNDL2	PWR	Ground for CPU outputs.
35, 36, 39, 40	CPUCLK (3:0)	OUT	CPU and Host clock outputs @ 2.5V
42	N/C	-	Not internally connected
43	GNDL1	PWR	Ground for IOAPIC outputs
44, 45	IOAPIC (0:1)	OUT	IOAPIC outputs (14.318MHz) @ 2.5V
46	VDDL1	PWR	Power for IOAPIC outputs, nominally 2.5V
47	SS_SEL	IN	±.25% Spread Spectrum Selector at power up. Logic 0 for Downspread Logic 1 for Centerspread
	REF2	OUT	14.318MHz clock output
48	VDD1	PWR	Supply for REF (0:2), X1, X2, nominal 3.3V

Select Functions

Functionality	CPU	PCI, PCI_F	REF	IOAPIC	48 MHz Selection
Tristate	HI - Z	HI - Z	HI - Z	HI - Z	HI - Z
Testmode	TCLK/2[1]	TCLK/6[1]	TCLK[1]	TCLK[1]	TCLK/2[1]
Spread Spectrum	Modulated[2]	Modulated[2]	14.318MHz	14.318MHz	48.0MHz

FS2	FS1	FS0	CPU MHz	PCI MHz
0	0	0	133	33.25
0	0	1	83.3	41.65
0	1	0	75	37.5
0	1	1	66.6	33.3
1	0	0	124	41.33
1	0	1	133	44.3
1	1	0	112	37.3
1	1	1	100	33.3

Power Management

Clock Enable Configuration

CPU_STOP#	PCI_STOP#	PWR_DWN#	CPUCLK	PCICLK	Other Clocks, REF, IOAPICs, 48 MHz 0 48 MHz 1	Crystal	VCOs
X	X	0	Low	Low	Stopped	Off	Off
0	0	1	Low	Low	Running	Running	Running
0	1	1	Low	Running	Running	Running	Running
1	0	1	Running	Low	Running	Running	Running
1	1	1	Running	Running	Running	Running	Running

Full clock cycle timing is guaranteed at all times after the system has initially powered up except where noted. During power up and power down operations using the PD# select pin will not cause clocks of a shorter or longer pulse than that of the running clock. The first clock pulse coming out of a stopped clock condition may be slightly distorted due to clock network charging circuitry. Board routing and signal loading may have a large impact on the initial clock distortion also.

ICS9248-55 Power Management Requirements

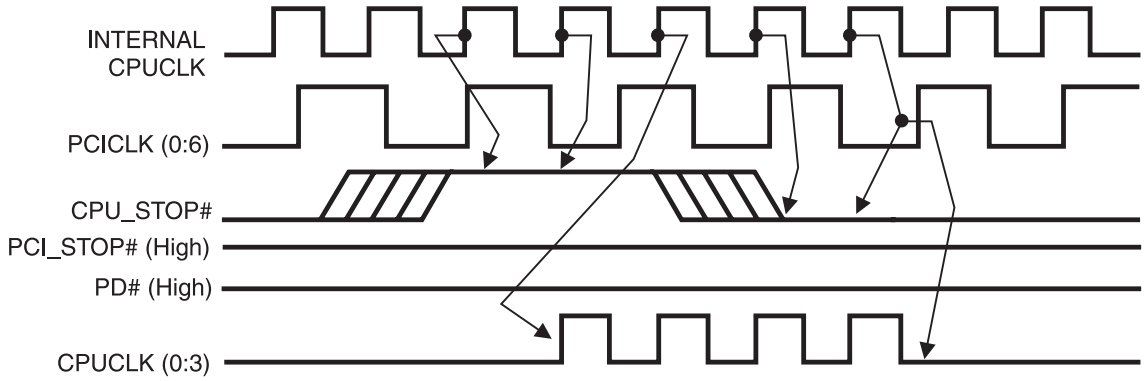
SIGNAL	SIGNAL STATE	Latency No. of rising edges of free running PCICLK
CPU_ STOP#	0 (Disabled)[2]	1
	1 (Enabled)[1]	1
PCI_STOP#	0 (Disabled)[2]	1
	1 (Enabled)[1]	1
PD#	1 (Normal Operation)[3]	3ms
	0 (Power Down)[4]	2max

Notes.

1. Clock on latency is defined from when the clock enable goes active to when the first valid clock comes out of the device.
2. Clock off latency is defined from when the clock enable goes inactive to when the last clock is driven low out of the device.
3. Power up latency is when PD# goes inactive (high) to when the first valid clocks are output by the device.
4. Power down has controlled clock counts applicable to CPUCLK, PCICLK only.
   The REF and IOAPIC will be stopped independent of these.

CPU_STOP# Timing Diagram

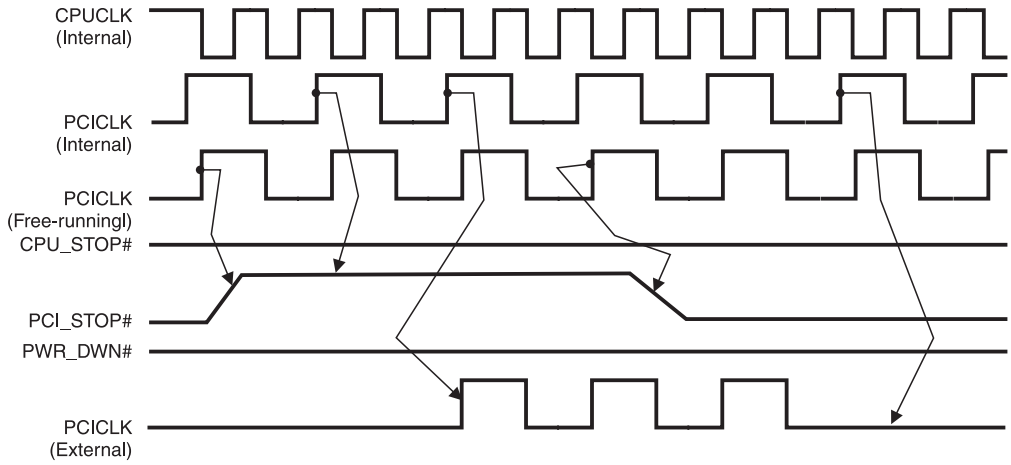
CPUSTOP# is an asychronous input to the clock synthesizer. It is used to turn off the CPUCLKs for low power operation. CPU_STOP# is synchronized by the **ICS9248-55**. The minimum that the CPUCLK is enabled (CPU_STOP# high pulse) is 100 CPUCLKs. All other clocks will continue to run while the CPUCLKs are disabled. The CPUCLKs will always be stopped in a low state and start in such a manner that guarantees the high pulse width is a full pulse. CPUCLK on latency is less than 4 CPUCLKs and CPUCLK off latency is less than 4 CPUCLKs.



Notes:
1. All timing is referenced to the internal CPUCLK.
2. CPU_STOP# is an asynchronous input and metastable conditions may exist. This signal is synchronized to the CPUCLKs inside the **ICS9248-55**.
3. All other clocks continue to run undisturbed.
4. PD# and PCI_STOP# are shown in a high (true) state.

PCI_STOP# Timing Diagram

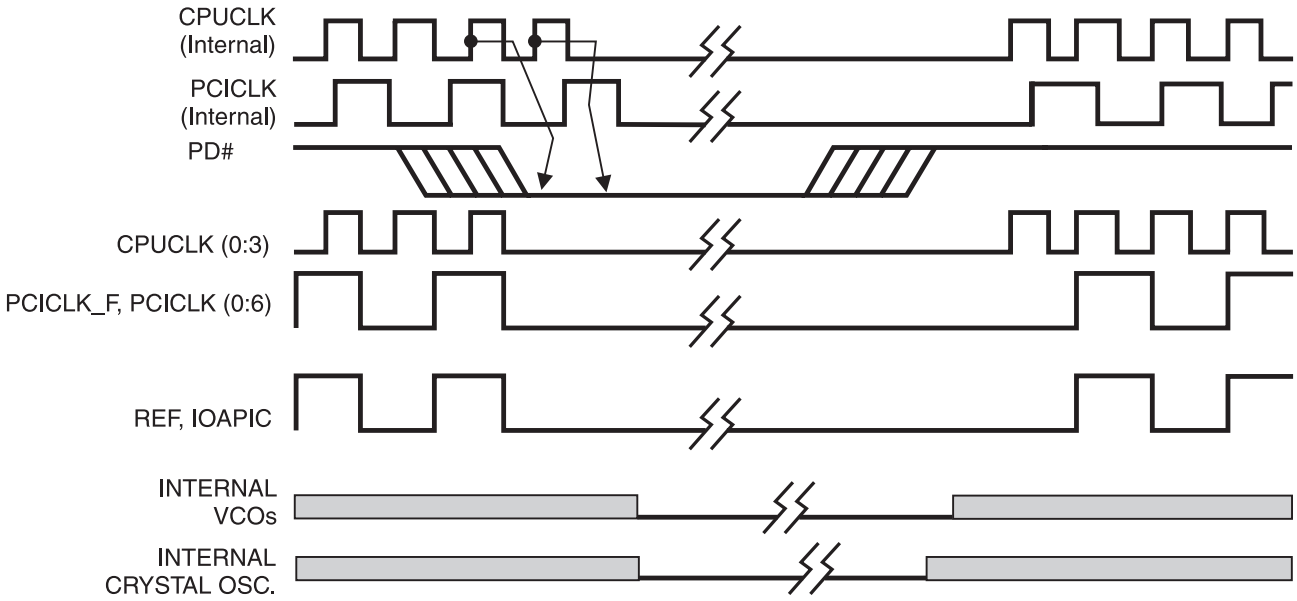
PCI_STOP# is an asynchronous input to the **ICS9248-55**. It is used to turn off the PCICLK (0:6) clocks for low power operation. PCI_STOP# is synchronized by the **ICS9248-55** internally. The minimum that the PCICLK (0:6) clocks are enabled (PCI_STOP# high pulse) is at least 10 PCICLK (0:6) clocks. PCICLK (0:6) clocks are stopped in a low state and started with a full high pulse width guaranteed. PCICLK (0:6) 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 ICS9248-55.
3. All other clocks continue to run undisturbed.
4. PD# and CPU_STOP# are shown in a high (true) state.

PD# Timing Diagram

The power down selection is used to put the part into a very low power state without turning off the power to the part. PD# is an asynchronous active low input. This signal is synchronized internally by the **ICS9248-55** prior to its control action of powering down the clock synthesizer. Internal clocks will not be running after the device is put in power down state. When PD# is active (low) all clocks are driven to a low state and held prior to turning off the VCOs and the Crystal oscillator. The power on latency is guaranteed to be less than 3ms. The power down latency is less than three CPUCLK cycles. PCI_STOP# and CPU_STOP# are don't care signals during the power down operations.



Notes:
1. All timing is referenced to the Internal CPUCLK (defined as inside the ICS9248 device).
2. PD# is an asynchronous input and metastable conditions may exist. This signal is synchronized inside the ICS9248.
3. The shaded sections on the VCO and the Crystal signals indicate an active clock is being generated.

Absolute Maximum Ratings

Supply Voltage ..... 7.0 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

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	170	mA
	$I_{DD3.3OP100}$	C_L = 0 pF; Select @ 100MHz		66	170	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
Settling Time[1]	T_s	From 1st crossing to 1% target Freq.		5		ms
Clk Stabilization[1]	T_{STAB}	From V_{DD} = 3.3 V to 1% target Freq.			3	ms
Skew[1]	$T_{CPU-PCI1}$	V_T = 1.5 V;	1.5	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]	$t_{CPU-PCI2}$	V_T = 1.5 V; V_{TL} = 1.25 V	1.5	3	4	ns

[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_{OH2B}	I_{OH} = -12.0 mA	2	2.3		V
Output Low Voltage	V_{OL2B}	I_{OL} = 12 mA		0.2	0.4	V
Output High Current	I_{OH2B}	V_{OH} = 1.7 V		-41	-19	mA
Output Low Current	I_{OL2B}	V_{OL} = 0.7 V	19	37		mA
Rise Time	t_{r2B}[1]	V_{OL} = 0.4 V, V_{OH} = 2.0 V		1.25	1.6	ns
Fall Time	t_{f2B}[1]	V_{OH} = 2.0 V, V_{OL} = 0.4 V		1	1.6	ns
Duty Cycle	d_{t2B}[1]	V_T = 1.25 V	45	48	55	%
Skew	t_{sk2B}[1]	V_T = 1.25 V		30	175	ps
Jitter, Cycle-to-cycle	$t_{jcyc-cyc2B}$[1]	V_T = 1.25 V		150	200	ps
Jitter, One Sigma	t_{j1s2B}[1]	V_T = 1.25 V		40	150	ps
Jitter, Absolute	t_{jabs2B}[1]	V_T = 1.25 V	-250	140	+250	ps

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

Electrical Characteristics - IOAPIC

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_{OH4B}	I_{OH} = -18 mA	2	2.2		V
Output Low Voltage	V_{OL4B}	I_{OL} = 18 mA		0.33	0.4	V
Output High Current	I_{OH4B}	V_{OH} = 1.7 V		-41	-28	mA
Output Low Current	I_{OL4B}	V_{OL} = 0.7 V	29	37		mA
Rise Time[1]	T_{r4B}	V_{OL} = 0.4 V, V_{OH} = 2.0 V		1.5	2	ns
Fall Time[1]	T_{f4B}	V_{OH} = 2.0 V, V_{OL} = 0.4 V		1.3	2	ns
Duty Cycle[1]	D_{t4B}	V_T = 1.25 V	45	54	55	%
Skew[1]	t_{sk4B}[1]	V_T = 1.25 V		60	250	ps
Jitter, One Sigma[1]	T_{j1s4B}	V_T = 1.25 V		1	3	%
Jitter, Absolute[1]	T_{jabs4B}	V_T = 1.25 V	-5		5	%

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

Electrical Characteristics - PCICLK

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

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output High Voltage	V_{OH1}	I_{OH} = -11 mA	2.4	3.1		V
Output Low Voltage	V_{OL1}	I_{OL} = 9.4 mA		0.1	0.4	V
Output High Current	I_{OH1}	V_{OH} = 2.0 V		-62	-22	mA
Output Low Current	I_{OL1}	V_{OL} = 0.8 V	16	57		mA
Rise Time[1]	t_{r1}	V_{OL} = 0.4 V, V_{OH} = 2.4 V		1.5	2	ns
Fall Time[1]	t_{f1}	V_{OH} = 2.4 V, V_{OL} = 0.4 V		1.1	2	ns
Duty Cycle[1]	d_{t1}	V_T = 1.5 V	45	50	55	%
Skew[1]	t_{sk1}	V_T = 1.5 V		140	500	ps
Jitter, One Sigma[1]	t_{j1s1}	V_T = 1.5 V		17	150	ps
Jitter, Absolute[1]	t_{jabs1}	V_T = 1.5 V	-500	70	500	ps

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

Electrical Characteristics - REF

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

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output High Voltage	V_{OH5}	I_{OH} = -12 mA	2.6	3.1		V
Output Low Voltage	V_{OL5}	I_{OL} = 9 mA		0.17	0.4	V
Output High Current	I_{OH5}	V_{OH} = 2.0 V		-44	-22	mA
Output Low Current	I_{OL5}	V_{OL} = 0.8 V	29	42		mA
Rise Time[1]	t_{r5}	V_{OL} = 0.4 V, V_{OH} = 2.4 V		1.4	2	ns
Fall Time[1]	t_{f5}	V_{OH} = 2.4 V, V_{OL} = 0.4 V		1.1	2	ns
Duty Cycle[1]	d_{t5}	V_T = 1.5 V	45	53	55	%
Jitter, One Sigma[1]	t_{j1s5}	V_T = 1.5 V		1	3	%
Jitter, Absolute[1]	t_{jabs5}	V_T = 1.5 V		3	5	%

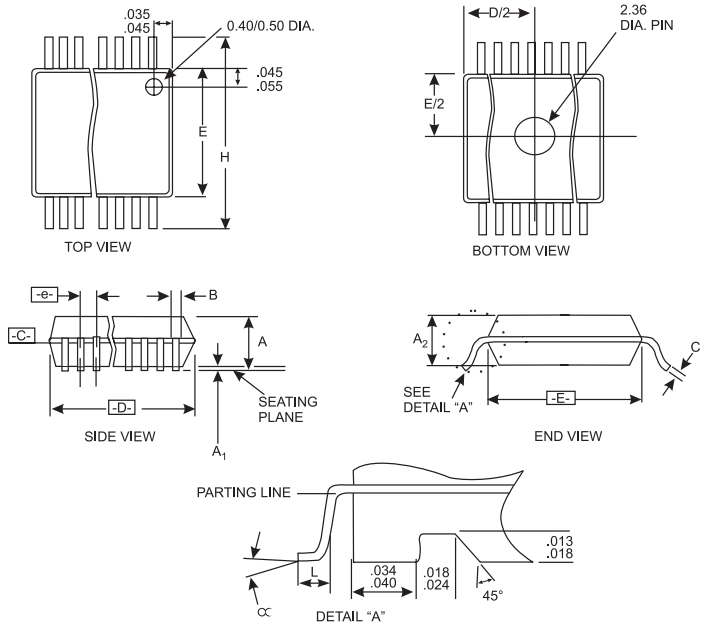
[1]Guaranteed by design, not 100% tested in production.

Electrical Characteristics - 48 MHz

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

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Frequency Accuracy[1]	F_{ACC48m}				167	ppm
Output High Voltage	V_{OH5}	I_{OH} = -12 mA	2.6	3		V
Output Low Voltage	V_{OL5}	I_{OL} = 9 mA		0.14	0.4	V
Output High Current	I_{OH5}	V_{OH} = 2.0 V		-44	-22	mA
Output Low Current	I_{OL5}	V_{OL} = 0.8 V	16	42		mA
Rise Time[1]	t_{r5}	V_{OL} = 0.4 V, V_{OH} = 2.4 V		1.2	4	ns
Fall Time[1]	t_{f5}	V_{OH} = 2.4 V, V_{OL} = 0.4 V		1.2	4	ns
Duty Cycle[1]	d_{t5}	V_T = 1.5 V	45	52	55	%
Jitter, One Sigma[1]	t_{j1s5}	V_T = 1.5 V		1	3	%
Jitter, Absolute[1]	t_{jabs5}	V_T = 1.5 V		3	5	%

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



SSOP Package

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	AD	.720	.725	.730	56
A2	.088	.090	.092					
B	.008	.010	.0135					
C	.005	.006	.0085					
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					

This table in inches

Ordering Information

ICS9248BF-55

Example:

ICS XXXX F - PPP

- **Pattern Number (2 or 3 digit number for parts with ROM code patterns)**
- **Package Type**
  F=SSOP
- **Device Type (consists of 3 or 4 digit numbers)**
- **Prefix**
  ICS, AV = Standard Device