PRELIMINARY

Integrated Circuit Systems, Inc.

ICS842023I

FEMTOCLOCKS™ CRYSTAL-TO- HSTL CLOCK GENERATOR

GENERAL DESCRIPTION

The ICS842023I is an Ethernet Clock Generator and a member of the HiPerClocks™ family of high performance devices from ICS. For Ethernet applications, a 25MHz crystal is used to generate 250MHz. The ICS842023I uses ICS' 3rd generation low phase noise VCO technology and can achieve <1ps rms phase jitter, easily meeting Ethernet jitter requirements. The ICS842023I is packaged in a small 8-pin TSSOP, making it ideal for use in systems with limited board space.

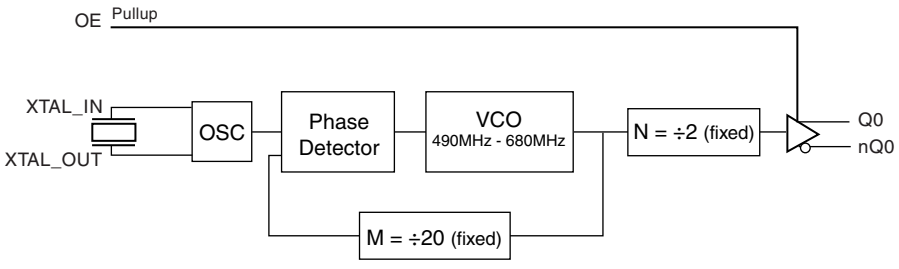
FEATURES

- (1) Differential HSTL output
- Crystal oscillator interface, 18pF parallel resonant crystal (24.5MHz - 34MHz)
- Output frequency range: 245MHz - 340MHz
- VCO range: 490MHz - 680MHz
- RMS phase jitter @ 250MHz, using a 25MHz crystal (1.875Hz - 20MHz): 0.33ps (typical)
- 3.3V or 2.5V operating supply
- -40°C to 85°C ambient operating temperature

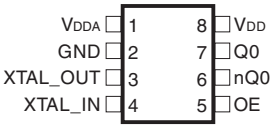
COMMON CONFIGURATION TABLE - 1 Gb ETHERNET

Inputs				Output Frequency (MHz)
Crystal Frequency (MHz)	M	N	Multiplication Value M/N	
25	20	2	10	250

BLOCK DIAGRAM



PIN ASSIGNMENT



ICS842023I

8-Lead TSSOP
4.40mm x 3.0mm x 0.925mm
package body
G Package
Top View

The Preliminary Information presented herein represents a product in prototyping or pre-production. The noted characteristics are based on initial product characterization. Integrated Circuit Systems, Incorporated (ICS) reserves the right to change any circuitry or specifications without notice.

TABLE 1. PIN DESCRIPTIONS

Number	Name	Type		Description
1	V_{DDA}	Power		Analog supply pin.
2	GND	Power		Power supply ground.
3, 4	XTAL_OUT, XTAL_IN	Input		Crystal oscillator interface. XTAL_IN is the input, XTAL_OUT is the output.
5	OE	Input	Pullup	Output enable pin. When HIGH, Q0/nQ0 output is active. When LOW, the Q0/nQ0 output is in a high impedance state. LVCMOS/LVTTL interface levels.
6, 7	nQ0, Q0	Output		Differential clock outputs. HSTL interface levels.
8	V_{DD}	Power		Core supply pin.

NOTE: *Pullup* refers to internal input resistors. See Table 2, Pin Characteristics, for typical values.

TABLE 2. PIN CHARACTERISTICS

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
C_{IN}	Input Capacitance			4		pF
R_{PULLUP}	Input Pullup Resistor			51		kΩ

ABSOLUTE MAXIMUM RATINGS

Supply Voltage, V_{DD}	4.6V
Inputs, V_I	-0.5V to V_{DD} + 0.5V
Outputs, I_O	
Continuous Current	50mA
Surge Current	100mA
Package Thermal Impedance, θ_{JA}	101.7°C/W (0 mps)
Storage Temperature, T_{STG}	-65°C to 150°C

NOTE: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These ratings are stress specifications only. Functional operation of product at these conditions or any conditions beyond those listed in the *DC Characteristics* or *AC Characteristics* is not implied. Exposure to absolute maximum rating conditions for extended periods may affect product reliability.

TABLE 3A. POWER SUPPLY DC CHARACTERISTICS, $V_{DD} = V_{DDA}$ = 3.3V±5%, TA = -40°C TO 85°C

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
V_{DD}	Core Supply Voltage		3.135	3.3	3.465	V
V_{DDA}	Analog Supply Voltage		3.135	3.3	3.465	V
I_{DD}	Power Supply Current			TBD		mA
I_{DDA}	Analog Supply Current			TBD		mA

TABLE 3B. POWER SUPPLY DC CHARACTERISTICS, $V_{DD} = V_{DDA}$ = 2.5V±5%, TA = -40°C TO 85°C

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
V_{DD}	Core Supply Voltage		2.375	2.5	2.625	V
V_{DDA}	Analog Supply Voltage		2.375	2.5	2.625	V
I_{DD}	Power Supply Current			TBD		mA
I_{DDA}	Analog Supply Current			TBD		mA

TABLE 3C. LVCMOS/LVTTL DC CHARACTERISTICS, $V_{DD} = V_{DDA}$ = 3.3V±5% OR 2.5V±5%, TA = -40°C TO 85°C

Symbol	Parameter		Test Conditions	Minimum	Typical	Maximum	Units
V_{IH}	Input High Voltage		3.3V	2		V_{DD} + 0.3	V
			2.5V	1.7		V_{DD} + 0.3	V
V_{IL}	Input Low Voltage		3.3V	-0.3		0.8	V
			2.5V	-0.3		0.7	V
I_{IH}	Input High Current	OE	$V_{DD} = V_{IN}$ = 3.465V or 2.625V			5	µA
I_{IL}	Input Low Current	OE	V_{DD} = 3.465V or 2.625V, V_{IN} = 0V	-150			µA

TABLE 3D. HSTL DC CHARACTERISTICS, $V_{DD} = V_{DDA} = 3.3V \pm 5\%$, T_A = -40°C TO 85°C

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
V_{OH}	Output High Voltage; NOTE 1		1		1.8	V
V_{OL}	Output Low Voltage; NOTE 1		0		0.6	V
V_{OX}	Output Crossover Voltage; NOTE 2		40		60	%
V_{SWING}	Peak-to-Peak Output Voltage Swing		0.4		1.8	V

NOTE 1: Outputs terminated with 50Ω to GND.
NOTE 2: Defined with respect to output voltage swing at a given condition.

TABLE 3E. HSTL DC CHARACTERISTICS, $V_{DD} = V_{DDA} = 2.5V \pm 5\%$, T_A = -40°C TO 85°C

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
V_{OH}	Output High Voltage; NOTE 1		1		1.4	V
V_{OL}	Output Low Voltage; NOTE 1		0		0.4	V
V_{OX}	Output Crossover Voltage; NOTE 2		40		60	%
V_{SWING}	Peak-to-Peak Output Voltage Swing		0.6		1.4	V

NOTE 1: Outputs terminated with 50Ω to GND.
NOTE 2: Defined with respect to output voltage swing at a given condition.

TABLE 4. CRYSTAL CHARACTERISTICS

Parameter	Test Conditions	Minimum	Typical	Maximum	Units
Mode of Oscillation			Fundamental		
Frequency		24.5		34	MHz
Equivalent Series Resistance (ESR)				50	Ω
Shunt Capacitance				7	pF
Drive Level				1	mW

TABLE 5A. AC CHARACTERISTICS, $V_{DD} = V_{DDA} = 3.3V \pm 5\%$, T_A = -40°C TO 85°C

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
f_{OUT}	Output Frequency		245		340	MHz
$t$jit(Ø)	RMS Phase Jitter (Random); NOTE 1	250MHz @ Integration Range: 1.875MHz - 20MHz		0.33		ps
t_R / t_F	Output Rise/Fall Time	20% to 80%		300		ps
odc	Output Duty Cycle			50		%

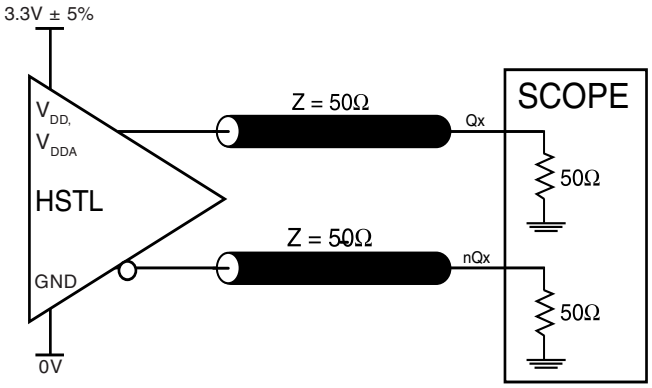
NOTE 1: Please refer to the Phase Noise Plots following this section.

TABLE 5B. AC CHARACTERISTICS, $V_{DD} = V_{DDA} = 2.5V \pm 5\%$, T_A = -40°C TO 85°C

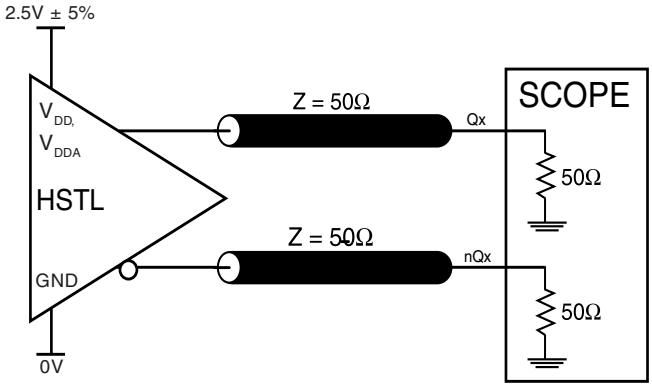
Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
f_{OUT}	Output Frequency		245		340	MHz
$t$jit(Ø)	RMS Phase Jitter (Random); NOTE 1	250MHz @ Integration Range: 1.875MHz - 20MHz		0.4		ps
t_R / t_F	Output Rise/Fall Time	20% to 80%		325		ps
odc	Output Duty Cycle			50		%

NOTE 1: Please refer to the Phase Noise Plots following this section.

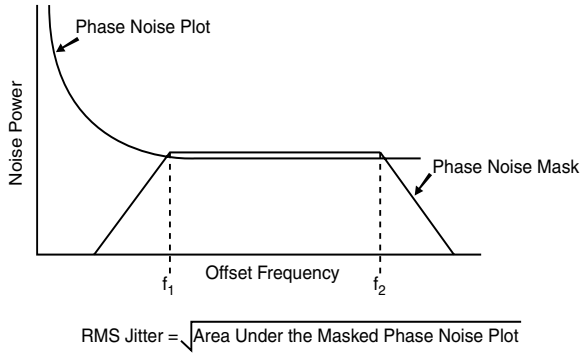
PARAMETER MEASUREMENT INFORMATION



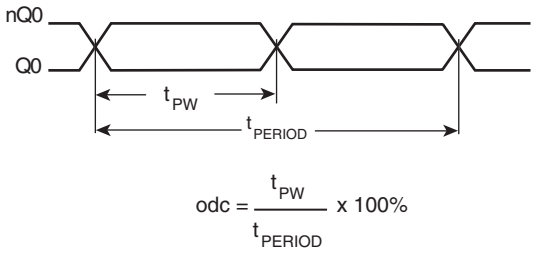
HSTL 3.3V OUTPUT LOAD AC TEST CIRCUIT



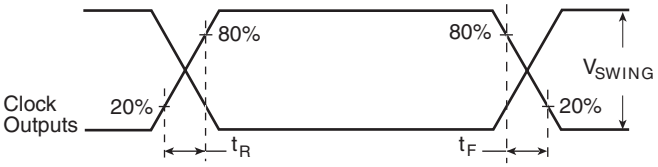
HSTL 2.5V OUTPUT LOAD AC TEST CIRCUIT



RMS PHASE JITTER



OUTPUT DUTY CYCLE/PULSE WIDTH/PERIOD



OUTPUT RISE/FALL TIME

APPLICATION INFORMATION

POWER SUPPLY FILTERING TECHNIQUES

As in any high speed analog circuitry, the power supply pins are vulnerable to random noise. The ICS842023I provides separate power supplies to isolate any high switching noise from the outputs to the internal PLL. V_{DD} and V_{DDA} should be individually connected to the power supply plane through vias, and bypass capacitors should be used for each pin. To achieve optimum jitter performance, power supply isolation is required. *Figure 1* illustrates how a 10Ω resistor along with a 10µF and a .01µF bypass capacitor should be connected to each V_{DDA} pin.

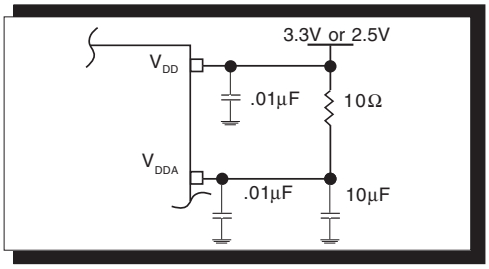


FIGURE 1. POWER SUPPLY FILTERING

CRYSTAL INPUT INTERFACE

The ICS842023I has been characterized with 18pF parallel resonant crystals. The capacitor values, C1 and C2, shown in *Figure 2* below were determined using a 25MHz, 18pF parallel resonant crystal and were chosen to minimize the ppm error. The optimum C1 and C2 values can be slightly adjusted for different board layouts.

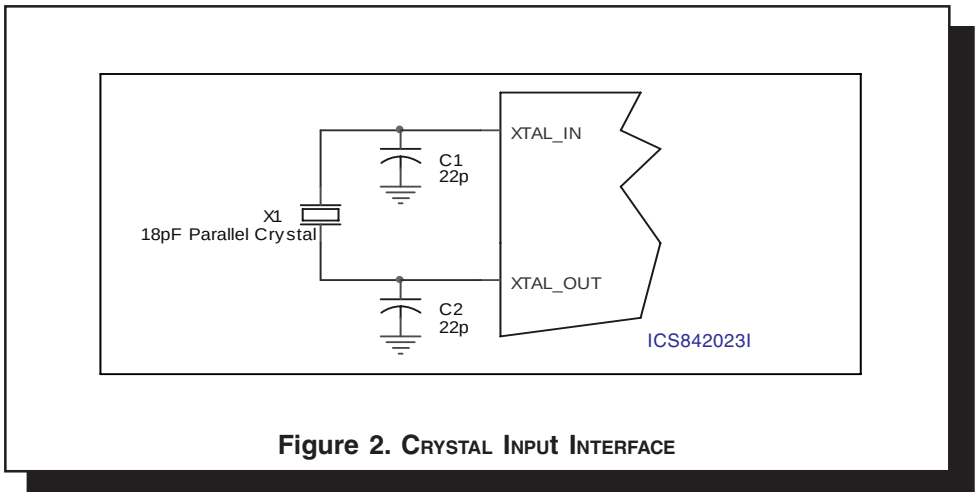


Figure 2. CRYSTAL INPUT INTERFACE

RELIABILITY INFORMATION

TABLE 6. θ_{JA} VS. AIR FLOW TABLE FOR 8 LEAD TSSOP

θ_{JA} by Velocity (Meters per Second)			
	0	**1**	**2.5**
Multi-Layer PCB, JEDEC Standard Test Boards	101.7°C/W	90.5°C/W	89.8°C/W

TRANSISTOR COUNT

The transistor count for ICS842023I is: 2538

PACKAGE OUTLINE - G SUFFIX FOR 8 LEAD TSSOP

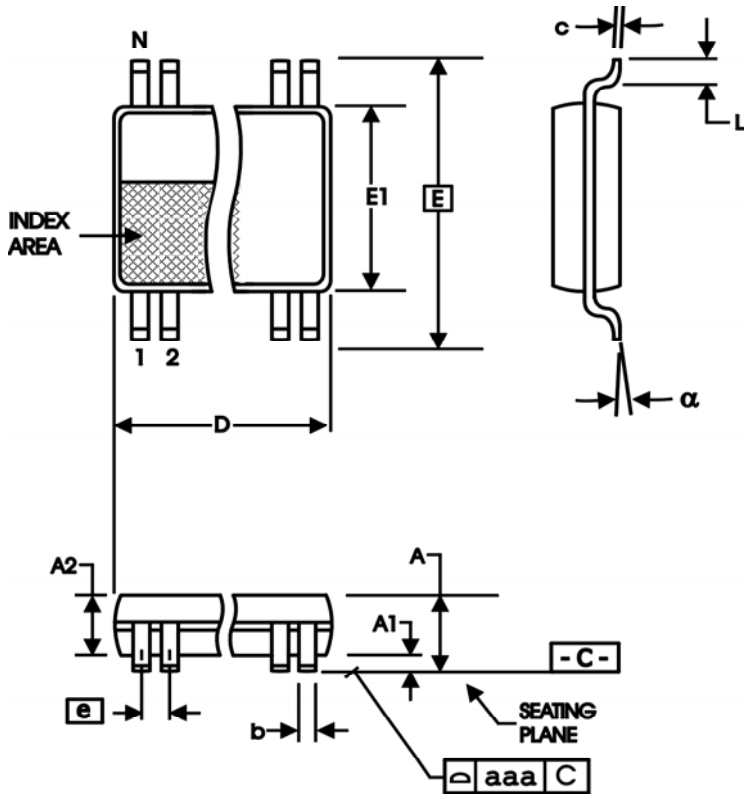


TABLE 7. PACKAGE DIMENSIONS

SYMBOL	Millimeters	
	Minimum	Maximum
N	8	
A	--	1.20
A1	0.05	0.15
A2	0.80	1.05
b	0.19	0.30
c	0.09	0.20
D	2.90	3.10
E	6.40 BASIC	
E1	4.30	4.50
e	0.65 BASIC	
L	0.45	0.75
α	0°	8°
aaa	--	0.10

Reference Document: JEDEC Publication 95, MO-153

TABLE 8. ORDERING INFORMATION

Part/Order Number	Marking	Package	Shipping Packaging	Temperature
ICS842023AGI	2023A	8 Lead TSSOP	tube	-40°C to 85°C
ICS842023AGIT	2023A	8 Lead TSSOP	2500 tape & reel	-40°C to 85°C