SYSTEM PERIPHERAL CLOCK SOURCE

ICS650-01

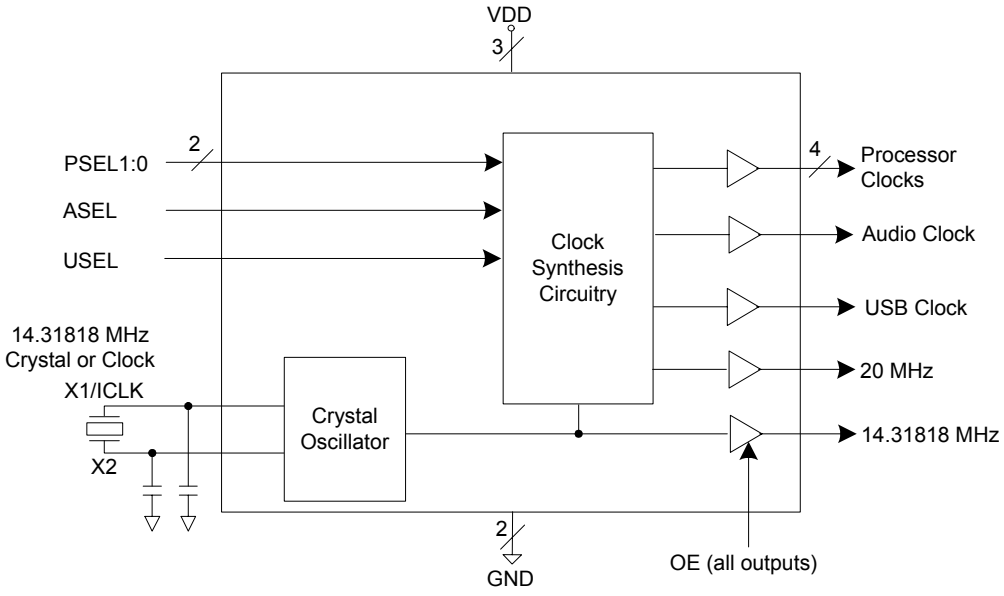
Description

The ICS650-01 is a low-cost, low-jitter, high-performance clock synthesizer for system peripheral applications. Using analog/digital Phase-Locked Loop (PLL) techniques, the device accepts a parallel resonant 14.31818 MHz crystal input to produce up to eight output clocks. The device provides clocks for PCI, SCSI, Fast Ethernet, Ethernet, USB, and AC97. The user can select one of three USB frequencies and also one of two AC97 audio frequencies. The OE pin puts all outputs into a high impedance state for board level testing. All frequencies are generated with less than one ppm error, meeting the demands of SCSI and Ethernet clocking.

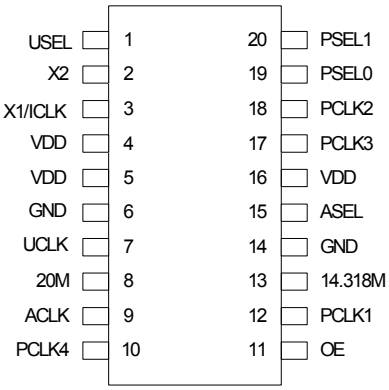
Features

- Packaged in 20-pin SSOP (QSOP)
- Pb (lead) free package
- Operating voltage of 3.3 V or 5 V
- Less than one ppm synthesis error in all clocks
- Inexpensive 14.31818 MHz crystal or clock input
- Provides Ethernet and Fast Ethernet clocks
- Provides SCSI clocks
- Provides PCI clocks
- Selectable AC97 audio clock
- Selectable USB clock
- OE pin tri-states the outputs for testing
- Selectable frequencies on three clocks
- Duty cycle of 40/60
- Advanced, low-power CMOS process
- Industrial temperature range available

Block Diagram



Pin Assignment



20 pin (150 mil) SSOP

USB Clock (MHz)

USEL	UCLK
0	12
M	24
1	48

Processor Clock (MHz)

PSEL1	PSEL0	PCLK1	PCLK2, 3	PCLK4
0	0	25	50	18.75
0	M	TEST	TEST	TEST
0	1	TEST	TEST	TEST
M	0	40	80	20
M	M	33.3334	66.6667	25
M	1	20	40	25
1	0	20	33.3334	25
1	M	20	66.6667	25
1	1	Stops low all clocks except 20M		

Audio Clock (MHz)

ASEL	ACLK
0	49.152
M	24.576
1	12.288

0 = connect directly to ground

1 = connect directly to VDD

M = leave unconnected (floating)

Pin Descriptions

Pin Number	Pin Name	Pin Type	Pin Description
1	USEL	Input	UCLK select pin. Determines frequency of USB clock per table above.
2	X2	XO	Crystal connection. Connect to parallel mode 14.31818 MHz crystal. Leave open for clock.
3	X1/ICLK	XI	Crystal connection. Connect to parallel mode 14.31818 MHz crystal or clock.
4	VDD	Power	Connect to VDD. Must be same value as other VDD. Decouple with pin 6.
5	VDD	Power	Connect to VDD. Must be same value as other VDD.
6	GND	Power	Connect to ground.
7	UCLK	Output	USB clock output per table above.
8	20M	Output	Fixed 20 MHz output for Ethernet. Only clock that runs when PSEL1=PSEL0=1.
9	ACLK	Output	AC97 audio clock output per table above.
10	PCLK4	Output	PCLK output number 4 per table above.

Pin Number	Pin Name	Pin Type	Pin Description
11	OE	Input	Output enable. Tri-states all outputs when low.
12	PCLK1	Output	PCLK output number 1 per table above.
13	14.318M	Output	14.31818 MHz Buffered reference clock output.
14	GND	Power	Connect to ground.
15	ASEL	Input	ACLK select pin. Determines frequency of Audio clock per table above.
16	VDD	Power	Connect to VDD. Must be same value as other VDD. Decouple with pin 14.
17	PCLK3	Output	PCLK output number 3 per table above.
18	PCLK2	Output	PCLK output number 2 per table above.
19	PSEL0	Input	Processor select pin #0. Determines frequencies on PCLKs 1-4 per table above.
20	PSEL1	Input	Processor select pin #1. Determines frequencies on PCLKs 1-4 per table above.

External Components

The ICS650-01 requires a minimum number of external components for proper operation.

Decoupling Capacitor

Decoupling capacitors of 0.01µF must be connected between each VDD and GND (pins 4 and 6, pins 16 and 14), as close to the device as possible. For optimum device performance, the decoupling capacitor should be mounted on the component side of the PCB. Avoid the use of vias in the decoupling circuit.

Series Termination Resistor

When the PCB trace between the clock outputs and the loads are over 1 inch, series termination should be used. To series terminate a 50Ω trace (a commonly used trace impedance) place a 33Ω resistor in series with the clock line, as close to the clock output pin as possible. The nominal impedance of the clock output is 20Ω

Crystal Information

The crystal used should be a fundamental mode (do not use third overtone), parallel resonant, 300 ppm or better (to meet Ethernet specs). Crystal capacitors should be connected from pins X1 to ground and X2 to ground to optimize the initial accuracy. The value of these capacitors is given by the following equation:

$$\text{Crystal caps (pF)} = (C_L - 12) \times 2$$

In the equation, C_L is the crystal load capacitance. So, for a crystal with a 16 pF load capacitance, two 8 pF capacitors should be used. If a clock input is used, drive it into X1 and leave X2 unconnected.

Absolute Maximum Ratings

Stresses above the ratings listed below can cause permanent damage to the ICS650-01. These ratings, which are standard values for IDT commercially rated parts, are stress ratings only. 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 can affect product reliability. Electrical parameters are guaranteed only over the recommended operating temperature range.

Item	Rating
Supply Voltage, VDD	7 V
All Inputs and Outputs	-0.5 V to VDD+0.5 V
Ambient Operating Temperature	0 to +70° C
Storage Temperature	-65 to +150° C
Junction Temperature	125° C
Soldering Temperature	260° C

Recommended Operation Conditions

Parameter	Min.	Typ.	Max.	Units
Ambient Operating Temperature	0		+70	° C
Power Supply Voltage (measured in respect to GND)	+3.0	+3.3	+5.5	V

DC Electrical Characteristics

Unless stated otherwise, **VDD = 3.3 V ±5% (or 5 V unless noted)**, Ambient Temperature 0 to +70° C

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Operating Voltage	VDD		3.0		5.5	V
Supply Current	IDD	At 5 V, No load, Note 1		50		mA
Supply Current	IDD	At 3.3 V, No load, Note 1		30		mA
Input High Voltage	V_{IH}	Select inputs, OE	2			V
Input Low Voltage	V_{IL}	Select inputs, OE			0.8	V
Output High Voltage	V_{OH}	VDD = 3.3 V, I_{OH} = -8 mA	2.4			V
Output High Voltage	V_{OH}	VDD = 3.3 V or 5 V, I_{OH} = -8 mA	VDD-0.4			V
Output Low Voltage	V_{OL}	VDD = 3.3 V, I_{OL} = 8mA			0.4	V
Short Circuit Current	I_{OS}	VDD = 3.3 V, each output		±50		mA
Input Capacitance		Except X1		7		pF

Note 1: With all clocks at highest frequencies.

AC Electrical Characteristics

Unless stated otherwise, **VDD = 3.3 V ±5% (or 5 V unless noted)**, Ambient Temperature 0 to +70° C

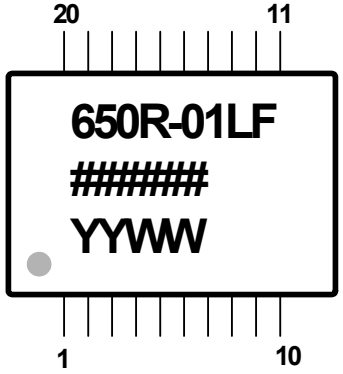
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Input Frequency				14.31818		MHz
Output Clocks Accuracy (synthesis error)		All clocks			1	ppm
Output Rise Time	t_{OR}	0.8 to 2.0 V, Note 1		1.5		ns
Output Fall Time	t_{OF}	2.0 to 0.8 V, Note 1		1.5		ns
Output Clock Duty Cycle		At VDD/2	40	50	60	%
One Sigma Jitter		except ACLK		75		ps
		ACLK		170		ps
Absolute Clock Period Jitter		PCLK, UCLK, 20M	-500		500	ps

Note 1: Measured with 15 pF load

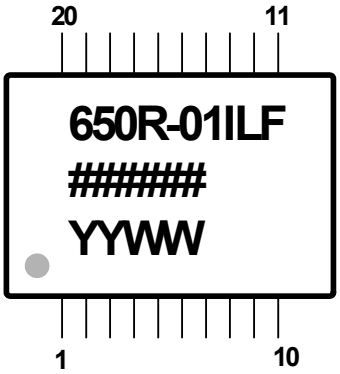
Thermal Characteristics

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Thermal Resistance Junction to Ambient	θ_{JA}	Still air		135		°C/W
	θ_{JA}	1 m/s air flow		93		°C/W
	θ_{JA}	3 m/s air flow		78		°C/W
Thermal Resistance Junction to Case	θ_{JC}			60		°C/W

Marking Diagram—ICS650R-01LF



Marking Diagram—ICS650R-01ILF

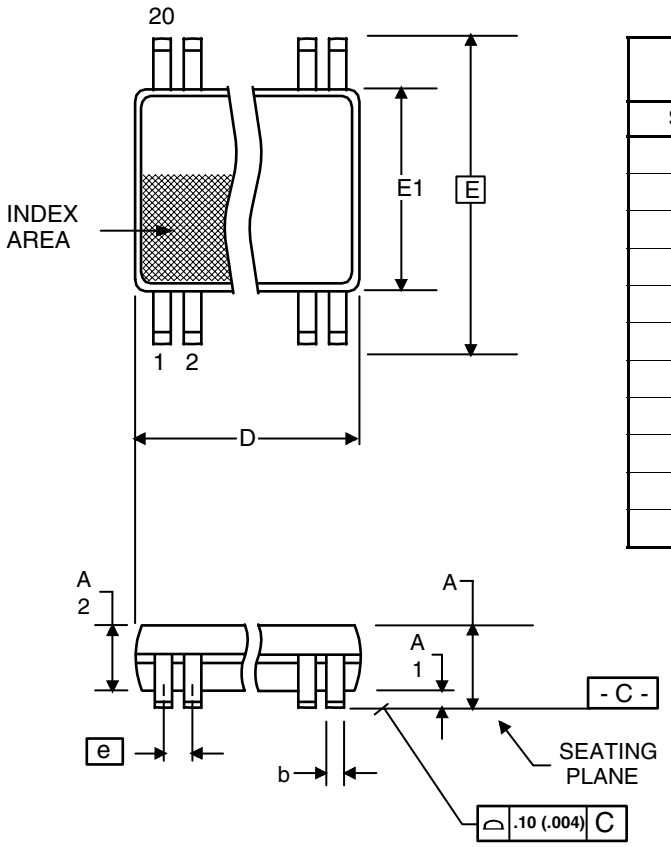


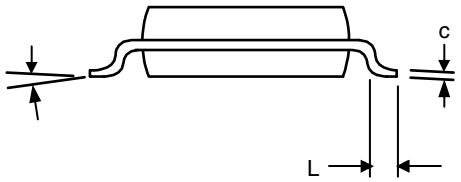
Notes:

1. ###### is the lot code.
2. YYWW is the last two digits of the year, and the week number that the part was assembled.
3. “LF” denotes Pb (lead) free package.
4. “I” denotes industrial grade device.
5. Bottom marking: (origin) = country of origin if not USA.

Package Outline and Package Dimensions (20-pin SSOP, 150 Mil. Body)

Package dimensions are kept current with JEDEC Publication No. 95





	Millimeters		Inches	
Symbol	Min	Max	Min	Max
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
A2	--	1.50	--	0.059
b	0.20	0.30	0.008	0.012
c	0.18	0.25	0.007	0.010
D	8.55	8.75	0.337	0.344
E	5.80	6.20	0.228	0.244
E1	3.80	4.00	0.150	0.157
e	.635 Basic		.025 Basic	
L	0.40	1.27	0.016	0.050
α	0°	8°	0°	8°

Ordering Information

Part / Order Number	Marking	Shipping Packaging	Package	Temperature
650R-01LF	see page 6	Tubes	20-pin SSOP	0 to +70° C
650R-01LFT		Tape and Reel	20-pin SSOP	0 to +70° C
650R-01ILF		Tubes	20-pin SSOP	-40 to 85° C
650R-01ILFT		Tape and Reel	20-pin SSOP	-40 to 85° C

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