

To all our customers

Regarding the change of names mentioned in the document, such as Hitachi Electric and Hitachi XX, to Renesas Technology Corp.

The semiconductor operations of Mitsubishi Electric and Hitachi were transferred to Renesas Technology Corporation on April 1st 2003. These operations include microcomputer, logic, analog and discrete devices, and memory chips other than DRAMs (flash memory, SRAMs etc.) Accordingly, although Hitachi, Hitachi, Ltd., Hitachi Semiconductors, and other Hitachi brand names are mentioned in the document, these names have in fact all been changed to Renesas Technology Corp. Thank you for your understanding. Except for our corporate trademark, logo and corporate statement, no changes whatsoever have been made to the contents of the document, and these changes do not constitute any alteration to the contents of the document itself.

Renesas Technology Home Page: <http://www.renesas.com>

Renesas Technology Corp.
Customer Support Dept.
April 1, 2003

Cautions

Keep safety first in your circuit designs!

1. Renesas Technology Corporation puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage.

Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of nonflammable material or (iii) prevention against any malfunction or mishap.

Notes regarding these materials

1. These materials are intended as a reference to assist our customers in the selection of the Renesas Technology Corporation product best suited to the customer's application; they do not convey any license under any intellectual property rights, or any other rights, belonging to Renesas Technology Corporation or a third party.
2. Renesas Technology Corporation assumes no responsibility for any damage, or infringement of any third-party's rights, originating in the use of any product data, diagrams, charts, programs, algorithms, or circuit application examples contained in these materials.
3. All information contained in these materials, including product data, diagrams, charts, programs and algorithms represents information on products at the time of publication of these materials, and are subject to change by Renesas Technology Corporation without notice due to product improvements or other reasons. It is therefore recommended that customers contact Renesas Technology Corporation or an authorized Renesas Technology Corporation product distributor for the latest product information before purchasing a product listed herein.
The information described here may contain technical inaccuracies or typographical errors. Renesas Technology Corporation assumes no responsibility for any damage, liability, or other loss rising from these inaccuracies or errors.
Please also pay attention to information published by Renesas Technology Corporation by various means, including the Renesas Technology Corporation Semiconductor home page (<http://www.renesas.com>).
4. When using any or all of the information contained in these materials, including product data, diagrams, charts, programs, and algorithms, please be sure to evaluate all information as a total system before making a final decision on the applicability of the information and products. Renesas Technology Corporation assumes no responsibility for any damage, liability or other loss resulting from the information contained herein.
5. Renesas Technology Corporation semiconductors are not designed or manufactured for use in a device or system that is used under circumstances in which human life is potentially at stake. Please contact Renesas Technology Corporation or an authorized Renesas Technology Corporation product distributor when considering the use of a product contained herein for any specific purposes, such as apparatus or systems for transportation, vehicular, medical, aerospace, nuclear, or undersea repeater use.
6. The prior written approval of Renesas Technology Corporation is necessary to reprint or reproduce in whole or in part these materials.
7. If these products or technologies are subject to the Japanese export control restrictions, they must be exported under a license from the Japanese government and cannot be imported into a country other than the approved destination.
Any diversion or reexport contrary to the export control laws and regulations of Japan and/or the country of destination is prohibited.
8. Please contact Renesas Technology Corporation for further details on these materials or the products contained therein.

HD151TS302RP

Spread Spectrum Clock for EMI Solution



ADE-205-655E (Z)

Rev. 5
Oct. 2002

Description

The HD151TS302 is a high-performance Spread Spectrum Clock modulator. It is suitable for low EMI solution.

Features

- Supports 10 MHz to 60 MHz operation. (Designed for XIN = 24 MHz and 48 MHz)
- 1 copy of clock out with spread spectrum modulation @3.3 V
- 1 copy of reference clock @3.3 V
- Programmable spread spectrum modulation (-0.5%, -1.0%, -3.0% down spread modulation and spread spectrum disable mode.)
- SOP-8pin
- Pin to pin compatible with HD151TS301RP

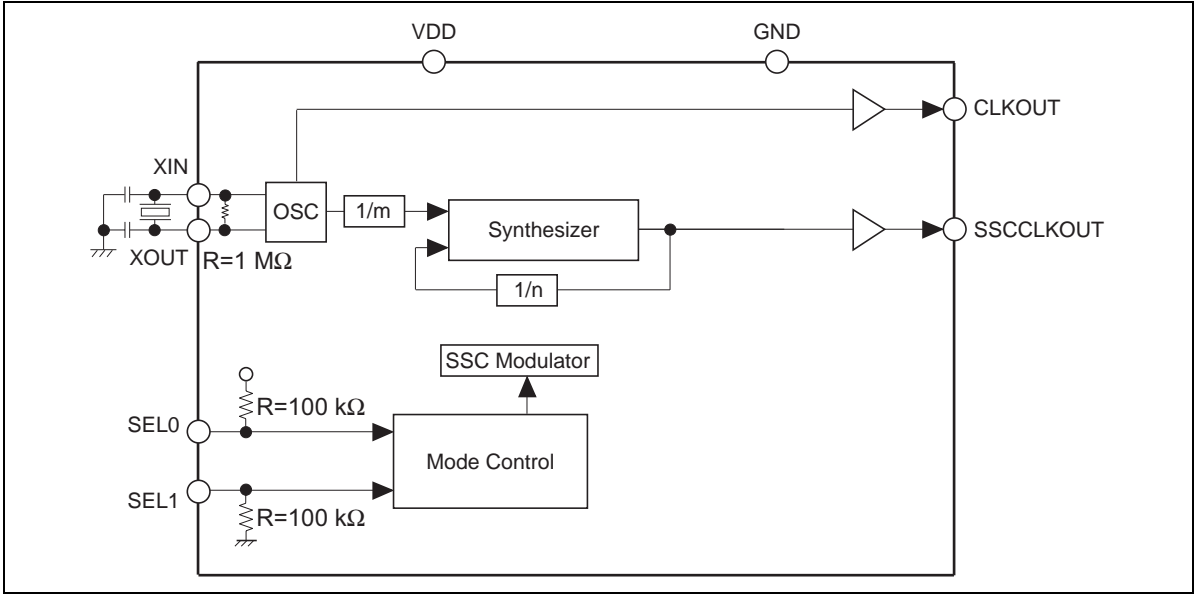
Key Specifications

- Supply voltages : VDD = 3.3 V \pm 0.165 V
- Ta = 0 to 70°C operating range
- Clock output duty cycle = 50 \pm 5%
- Cycle to cycle jitter = \pm 250 ps typ.
- Ordering Information

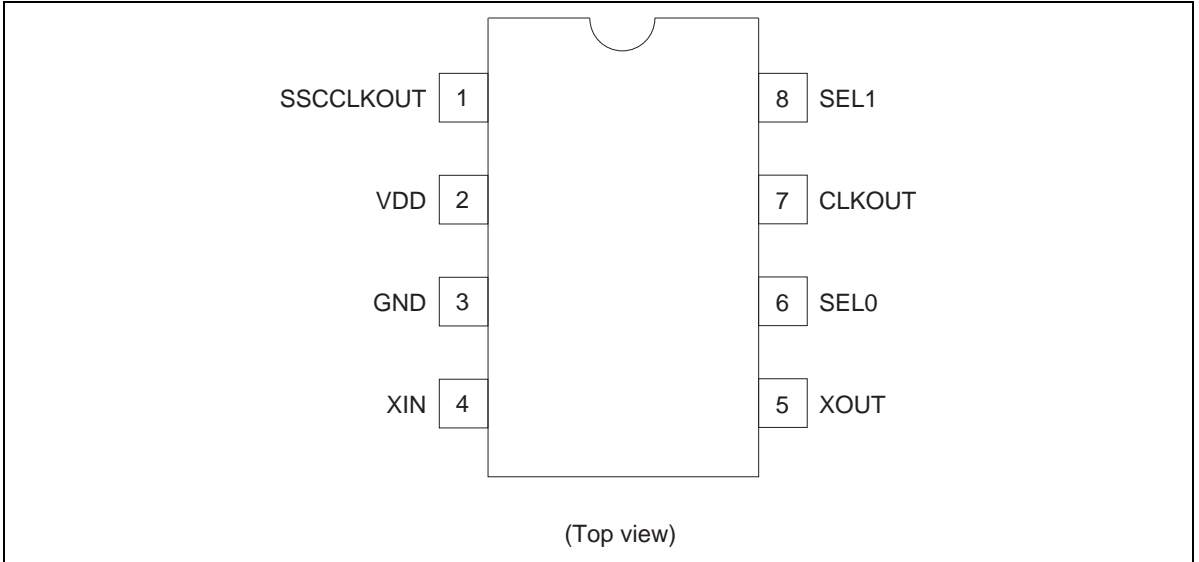
Part Name	Package Type	Package Code	Package Abbreviation	Taping Abbreviation (Quantity)
HD151TS302RPEL	SOP-8 pin (JEDEC)	FP-8DC	RP	EL (2,500 pcs / Reel)

Note: Please consult the sales office for the above package availability.

Block Diagram



Pin Arrangement



SSC Function Table

SEL1 :0	Spread Percentage
0 0	-1.0%
0 1	-3.0%
1 0	SSC OFF
1 1	-0.5%

Note: -3.0% SSC is selected for default by internal pull-up & down resistors.

Clock Frequency Table

XIN(MHz)	SSCCLKOUT(MHz)	CLKOUT(MHz)
48	48 ^{*1}	48 ^{*2}
24	24 ^{*1}	24 ^{*2}

- Notes: 1. With spread spectrum modulation.
 2. Without spread spectrum modulation.

Pin Descriptions

Pin name	No.	Type	Description
GND	3	Ground	GND pin
VDD	2	Power	Power supplies pin. Normally 3.3 V.
CLKOUT	7	Output	Normally 3.3 V reference clock output.
SSCCLKOUT	1	Output	Spread spectrum modulated clock output.
XIN	4	Input	Oscillator input.
XOUT	5	Output	Oscillator output.
SEL0	6	Input	SSC mode select pin. LVCMOS level input. Pull-up by internal resistor. (100 kΩ).
SEL1	8	Input	SSC mode select pin. LVCMOS level input. Pull-down by internal resistor (100 kΩ).

Absolute Maximum Ratings

Item	Symbol	Ratings	Unit	Conditions
Supply voltage	VDD	-0.5 to 4.6	V	
Input voltage	V _I	-0.5 to 4.6	V	
Output voltage ^{*1}	V _O	-0.5 to VDD+0.5	V	
Input clamp current	I _{IK}	-50	mA	V _I < 0
Output clamp current	I _{OK}	-50	mA	V _O < 0
Continuous output current	I _O	±50	mA	V _O = 0 to VDD
Maximum power dissipation at Ta = 55°C (in still air)		0.7	W	
Storage temperature	T _{stg}	-65 to +150	°C	

Notes: Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute maximum rated conditions for extended periods may affect device reliability.

1. The input and output negative voltage ratings may be exceeded if the input and output clamp current ratings are observed.

Recommended Operating Conditions

Item	Symbol	Min	Typ	Max	Unit	Conditions
Supply voltage	VDD	3.135	3.3	3.465	V	
DC input signal voltage		-0.3	—	VDD+0.3	V	
High level input voltage	V _{IH}	2.0	—	VDD+0.3	V	
Low level input voltage	V _{IL}	-0.3	—	0.8	V	
Operating temperature	T _a	0	—	70	°C	
Input clock duty cycle		45	50	55	%	

DC Electrical Characteristics
 $T_a = 0 \text{ to } 70^\circ\text{C}$, $V_{DD} = 3.3 \text{ V} \pm 5\%$

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Input low voltage	V_{IL}	—	—	0.8	V	
Input high voltage	V_{IH}	2.0	—	—	V	
Input current	I_i	—	—	± 10	μA	$V_i = 0 \text{ V}$ or 3.465 V , $V_{DD} = 3.465 \text{ V}$, XIN pin
		—	—	± 100		$V_i = 0 \text{ V}$ or 3.465 V , $V_{DD} = 3.465 \text{ V}$, SEL0, SEL1 pins
Input slew rate		1	—	4	V / ns	20% – 80%
Input capacitance	C_i	—	—	4	pF	SEL0, SEL1
Operating current		—	7	—	mA	XIN = 24 MHz, $C_L = 0 \text{ pF}$, $V_{DD} = 3.3 \text{ V}$

DC Electrical Characteristics / Clock Output & SSC Clock Output
 $T_a = 0 \text{ to } 70^\circ\text{C}$, $V_{DD} = 3.3 \text{ V} \pm 5\%$

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Output voltage	V_{OH}	3.1	—	—	V	$I_{OH} = -1 \text{ mA}$, $V_{DD} = 3.3 \text{ V}$
	V_{OL}	—	—	50	mV	$I_{OL} = 1 \text{ mA}$, $V_{DD} = 3.3 \text{ V}$
Output current * ¹	I_{OH}	—	-40	—	mA	$V_{OH} = 1.5 \text{ V}$
	I_{OL}	—	40	—		$V_{OL} = 1.5 \text{ V}$

Note: 1. Parameters are target of design. Not 100% tested in production.

AC Electrical Characteristics / Clock Output & SSC Clock Output

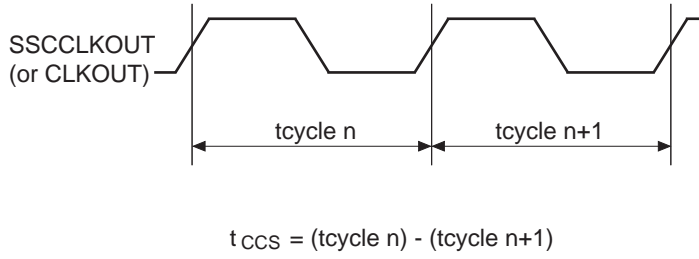
Ta = 25°C, VDD = 3.3 V, CL = 30 pF

Item	Symbol	Min	Typ	Max	Unit	Test Conditions	Notes
Cycle to cycle jitter ^{*1,2}	t _{ccs}	—	250	300		SSCCLKOUT, 24 MHz	SSCOFF SEL1:0 = 10
		—	250	300		SSCCLKOUT, 48 MHz	Fig1
		—	250	300		SSCCLKOUT, 24 MHz	SSC = -0.5% SEL1:0 = 11
		—	250	300		SSCCLKOUT, 48 MHz	Fig1
		—	250	300		SSCCLKOUT, 24 MHz	SSC = -3.0% SEL1:0 = 01
		—	250	300		SSCCLKOUT, 48 MHz	Fig1
		—	250	300		CLKOUT, 24 MHz & 48 MHz	Fig1
Output frequency ^{*1,2}		23.8	—	24.2	MHz	SSCCLKOUT, XIN = 24 MHz	SSCOFF SEL1:0 = 10
		47.3	—	48.7		SSCCLKOUT, XIN = 48 MHz	
		23.7	—	24.2		SSCCLKOUT, XIN = 24 MHz	SSC = -0.5% SEL1:0 = 11
		47.0	—	48.7		SSCCLKOUT, XIN = 48 MHz	
		23.1	—	24.2		SSCCLKOUT, XIN = 24 MHz	SSC = -3.0% SEL1:0 = 01
		45.9	—	48.7		SSCCLKOUT, XIN = 48 MHz	
		23.8	—	24.2		CLKOUT, 24 MHz	
		47.3	—	48.7		CLKOUT, 48 MHz	
Slew rate ^{*1}	t _{SL}	1.0	—	—	V/ns	@48 MHz CLKOUT	0.4 V to 2.4 V
Clock duty cycle ^{*1}		45	50	55	%		
Output impedance ^{*1}		—	30	—	Ω		
Spread spectrum modulation frequency ^{*1}		—	33	—	KHz	@48 MHz SSCCLKOUT	
Input clock frequency		10	—	60	MHz		
Stabilization time ^{*1,3}		—	—	2	ms		

Notes: 1. Parameters are target of design. Not 100% tested in production.

2. Cycle to cycle jitter and output frequency are included spread spectrum modulation.

3. Stabilization time is the time required for the integrated circuit to obtain phase lock of its input signal after power up.

**Figure 1 Cycle to cycle jitter**

Application Information

1. Recommended Circuit Configuration

The power supply circuit of the optimal performance on the application of a system should refer to Fig. 2.

VDD decoupling is important to both reduce Jitter and EMI radiation.

The C1 decoupling capacitor should be placed as close to the VDD pin as possible, otherwise the increased trace inductance will negate its decoupling capability.

The C2 decoupling capacitor shown should be a tantalum type.

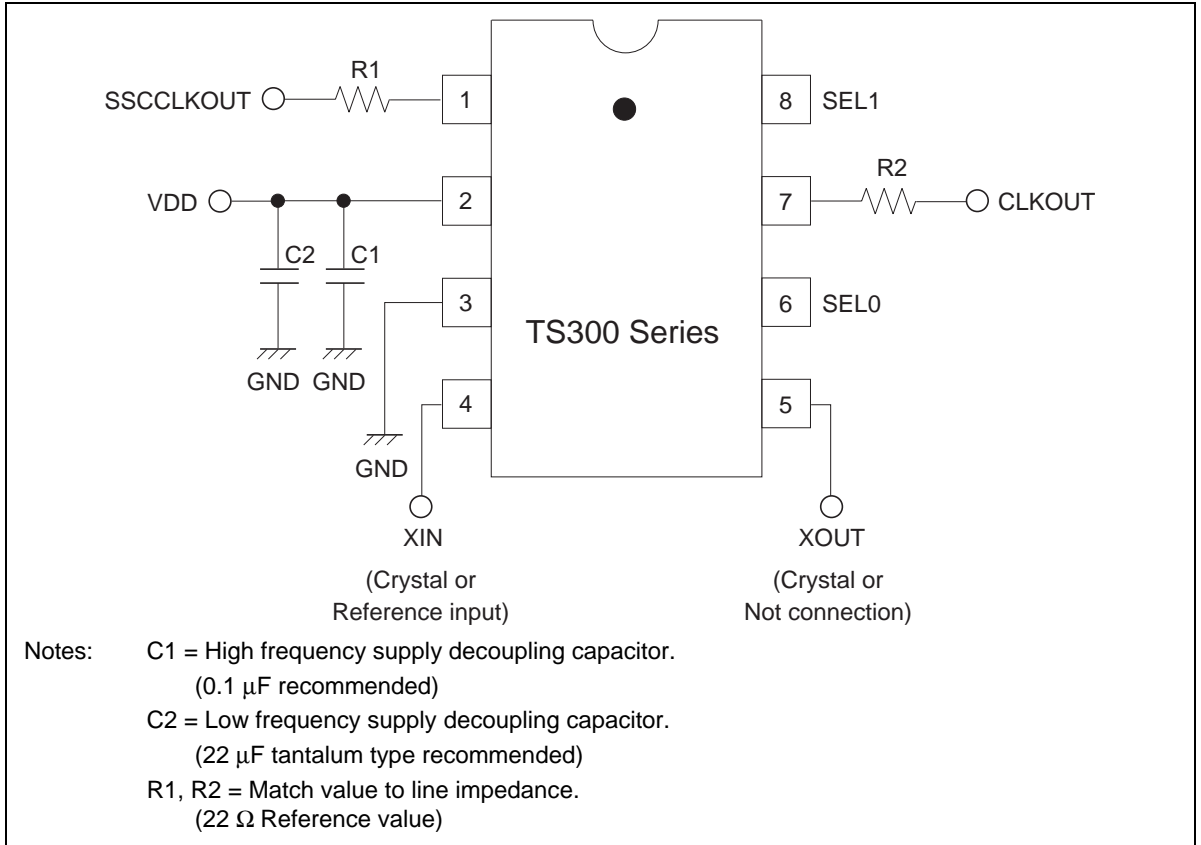


Figure 2 Recommended circuit configuration

2. Example Board Layout Configuration

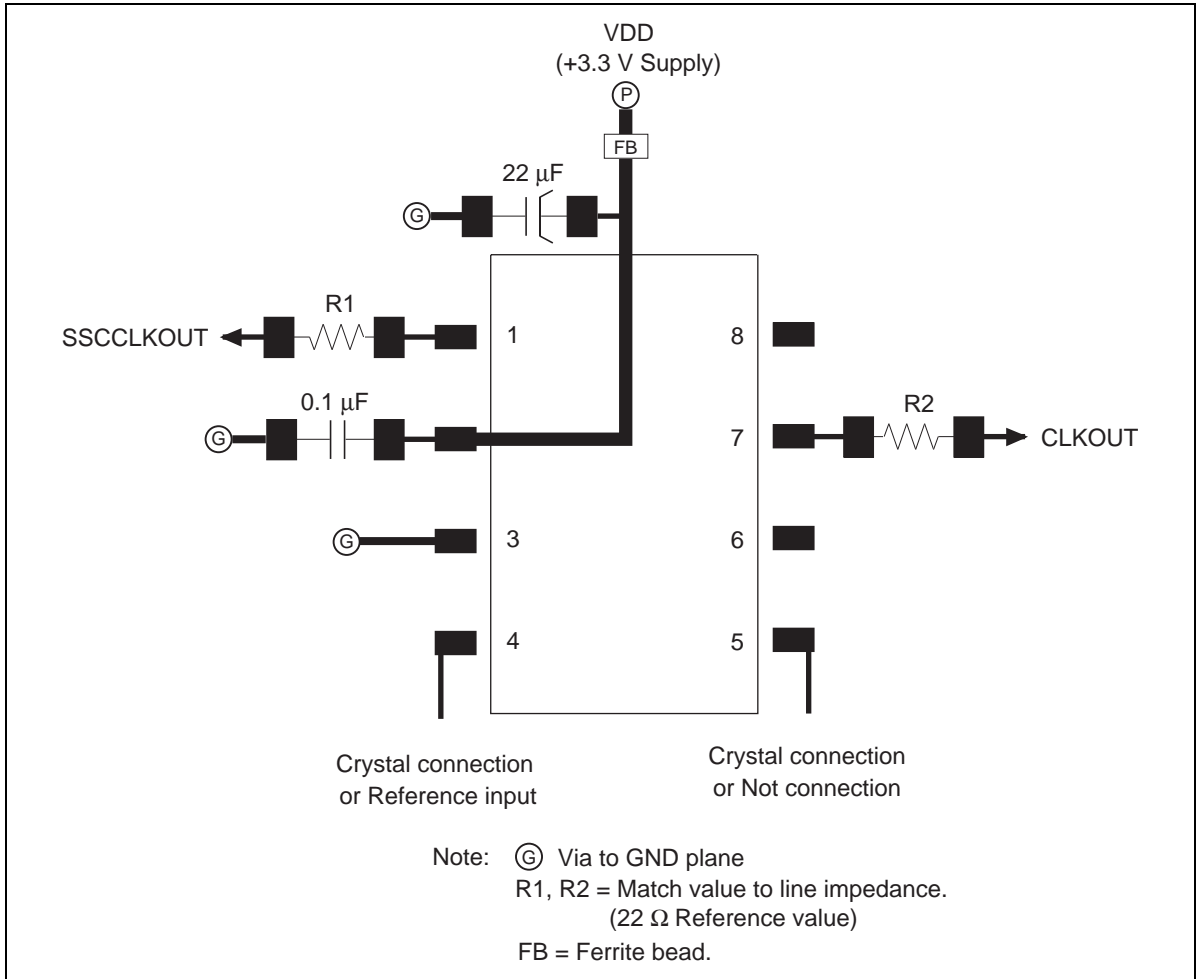


Figure 3 Example Board Layout

3. Example of TS300 EMI Solution IC's Application

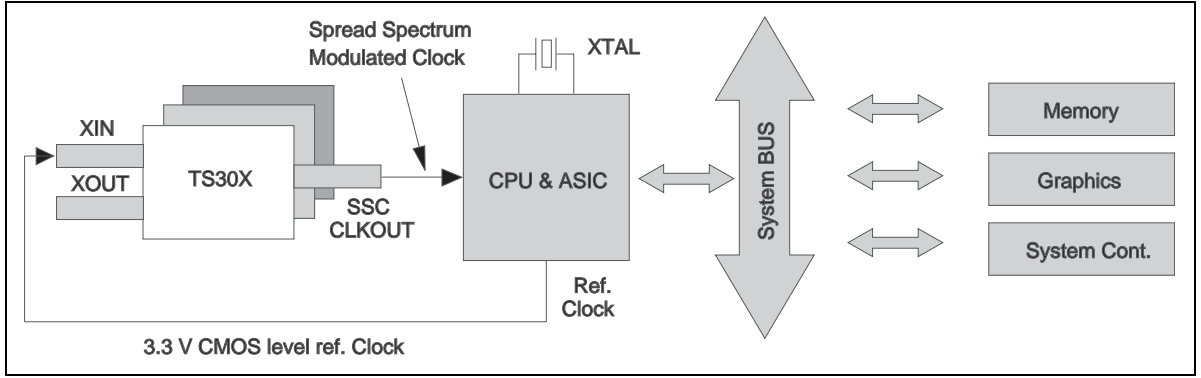


Fig 4 Ref. Clock Input Example

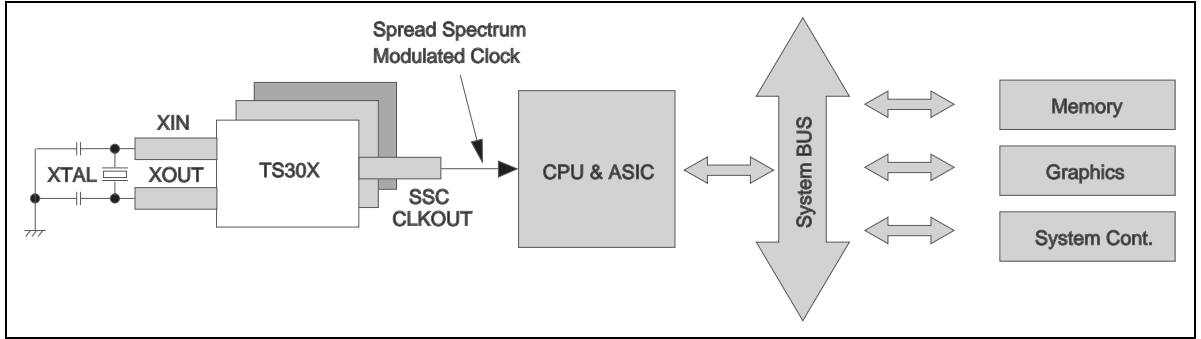
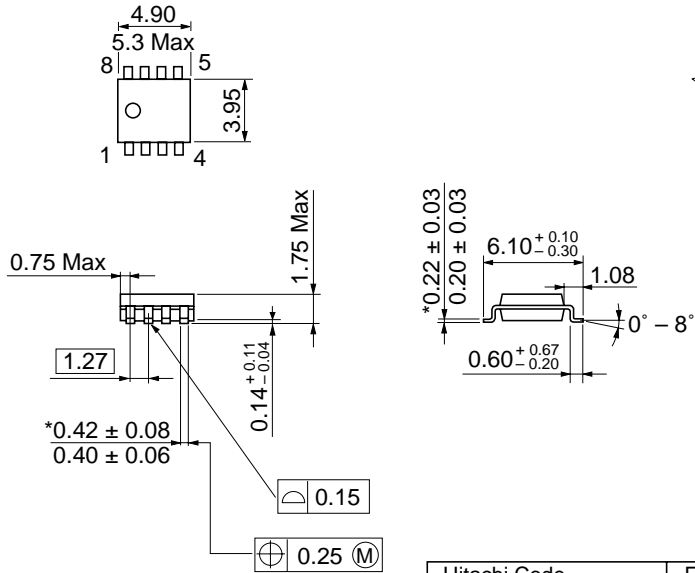


Fig 5 XTAL Ref. Clock Input Example

Package Dimensions

As of July, 2002
Unit: mm



*Dimension including the plating thickness
Base material dimension

Hitachi Code	FP-8DC
JEDEC	Conforms
JEITA	—
Mass (reference value)	0.085 g

Disclaimer

1. Hitachi neither warrants nor grants licenses of any rights of Hitachi's or any third party's patent, copyright, trademark, or other intellectual property rights for information contained in this document. Hitachi bears no responsibility for problems that may arise with third party's rights, including intellectual property rights, in connection with use of the information contained in this document.
2. Products and product specifications may be subject to change without notice. Confirm that you have received the latest product standards or specifications before final design, purchase or use.
3. Hitachi makes every attempt to ensure that its products are of high quality and reliability. However, contact Hitachi's sales office before using the product in an application that demands especially high quality and reliability or where its failure or malfunction may directly threaten human life or cause risk of bodily injury, such as aerospace, aeronautics, nuclear power, combustion control, transportation, traffic, safety equipment or medical equipment for life support.
4. Design your application so that the product is used within the ranges guaranteed by Hitachi particularly for maximum rating, operating supply voltage range, heat radiation characteristics, installation conditions and other characteristics. Hitachi bears no responsibility for failure or damage when used beyond the guaranteed ranges. Even within the guaranteed ranges, consider normally foreseeable failure rates or failure modes in semiconductor devices and employ systemic measures such as fail-safes, so that the equipment incorporating Hitachi product does not cause bodily injury, fire or other consequential damage due to operation of the Hitachi product.
5. This product is not designed to be radiation resistant.
6. No one is permitted to reproduce or duplicate, in any form, the whole or part of this document without written approval from Hitachi.
7. Contact Hitachi's sales office for any questions regarding this document or Hitachi semiconductor products.

Sales offices

HITACHI

Hitachi, Ltd.

Semiconductor & Integrated Circuits
Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan
Tel: (03) 3270-2111 Fax: (03) 3270-5109

URL <http://www.hitachisemiconductor.com/>

For further information write to:

Hitachi Semiconductor (America) Inc.
179 East Tasman Drive
San Jose, CA 95134
Tel: <1> (408) 433-1990
Fax: <1> (408) 433-0223

Hitachi Europe Ltd.
Electronic Components Group
Whitebrook Park
Lower Cookham Road
Maidenhead
Berkshire SL6 8YA, United Kingdom
Tel: <44> (1628) 585000
Fax: <44> (1628) 778322

Hitachi Europe GmbH
Electronic Components Group
Dornacher Str 3
D-85622 Feldkirchen
Postfach 201, D-85619 Feldkirchen
Germany
Tel: <49> (89) 9 9180-0
Fax: <49> (89) 9 29 30 00

Hitachi Asia Ltd.
Hitachi Tower
16 Collyer Quay #20-00
Singapore 049318
Tel: <65>-6538-6533/6538-8577
Fax: <65>-6538-6933/6538-3877
URL: <http://semiconductor.hitachi.com.sg>

Hitachi Asia Ltd.
(Taipei Branch Office)
4/F, No. 167, Tun Hwa North Road
Hung-Kuo Building
Taipei (105), Taiwan
Tel: <886>-(2)-2718-3666
Fax: <886>-(2)-2718-8180
Telex: 23222 HAS-TP
URL: <http://semiconductor.hitachi.com.tw>

Hitachi Asia (Hong Kong) Ltd.
Group III (Electronic Components)
7/F., North Tower
World Finance Centre,
Harbour City, Canton Road
Tsim Sha Tsui, Kowloon Hong Kong
Tel: <852>-2735-9218
Fax: <852>-2730-0281
URL: <http://semiconductor.hitachi.com.hk>

Copyright © Hitachi, Ltd., 2002. All rights reserved. Printed in Japan.
Colophon 7.0