ICS7151

Spread Spectrum Clock Generator

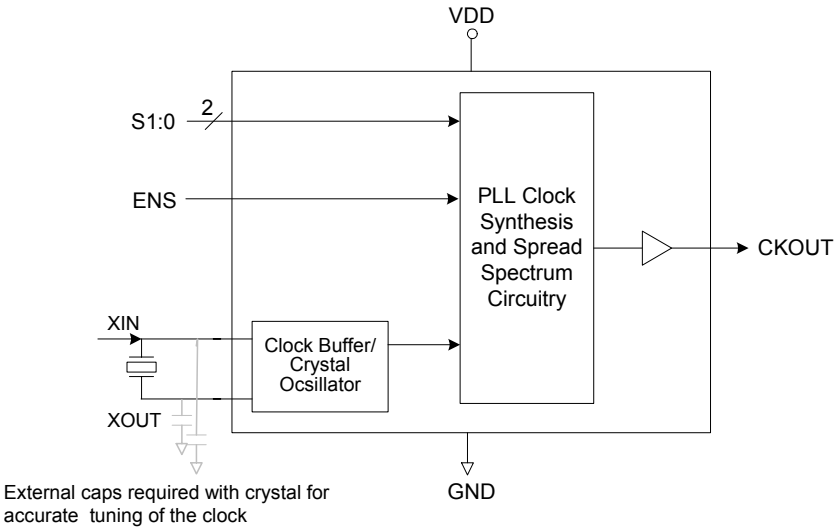
Description

The ICS7151-10, -20, -40, and -50 are clock generators for EMI (Electro Magnetic Interference) reduction (see below for frequency ranges and multiplier ratios). Spectral peaks can be attenuated by slightly modulating the oscillation frequency. Both down and center spread profiles are selectable. Down spread maintains an average frequency less than an unspread clock, and will not exceed the maximum frequency of an unspread clock.

Features

- Operating voltage of 3.3 V ±0.3 V
- Packaged in 8-pin SOIC
- Available in Pb (lead) free package
- Input frequency range of 16.5 to 33.4 MHz
- Output frequency ranges of 8.3 to 16.7 MHz, 16.5 to 33.4 MHz, 33.3 to 66.7 MHz, 66.6 to 133.4 MHz
- Provides a spread spectrum clock output (±0.5%, ±1.5% center spread; -1.0%, -3.0% down spread)
- Multiplication rates of x1/2, x1, x2, and x4
- Advanced, low-power CMOS process

Block Diagram

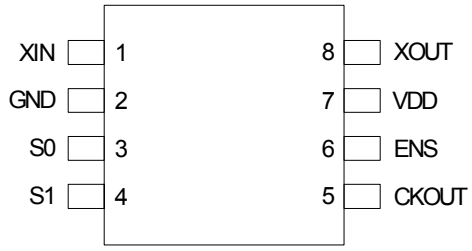


Product Lineup

Product	Input Frequency Range	Multiplier Ratio	Output Frequency Range
ICS7151M-10, ICS7151MI-10	16.5 MHz to 33.4 MHz	X1	16.5 MHz to 33.4 MHz
ICS7151M-20, ICS7151MI-20	16.5 MHz to 33.4 MHz	X2	33.3 MHz to 66.7 MHz
ICS7151M-40, ICS7151MI-40	16.5 MHz to 33.4 MHz	X4	66.6 MHz to 133.4 MHz
ICS7151M-50, ICS7151MI-50	16.5 MHz to 33.4 MHz	X1/2	8.3 MHz to 16.7 MHz

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Pin Assignment



8 pin (150 mil) SOIC

Spread Direction and Percentage Select Table

S1 Pin 4 (note1)	S0 Pin 3 (note1)	Spread Direction	Spread Percentage (%)
0	0	Center	±1.5
0	1	Center	±0.5
1	0	Down	-1.0
1	1	Down	-3.0

ENS (note 2)	Spread Spectrum
0	OFF
1	ON

Notes:

1. The modulation rate varies with input frequency.

2. Spread will default to ON when ENS pin is left open.

Pin Descriptions

Pin Number	Pin Name	Pin Type	Pin Description
1	XIN	Input	Resonator connection pin/clock input pin.
2	GND	Power	Connect to ground.
3	S0	Input	Select pin 0. Modulation rate setting pin.
4	S1	Input	Select pin 1. Modulation rate setting pin.
5	CKOUT	Output	Modulated clock output pin.
6	ENS	Input	Modulation enable setting pin. Internal pull-up resistor.
7	VDD	Power	Connect to +3.3 V.
8	XOUT	Output	Resonator connection pin.

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External Components

The ICS7151 requires a minimum number of external components for proper operation.

Decoupling Capacitor

A decoupling capacitor of 0.01µF must be connected between GND and VDD on pin 7, as close to this pin 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

Series termination should be used on the clock output. To series terminate a 50Ω trace (a commonly used trace impedance) place a 27Ω resistor in series with the clock line, as close to the clock output pin as possible. The nominal impedance of the clock output is 25Ω.

PCB Layout Recommendations

For optimum device performance and lowest output phase noise, the following guidelines should be observed.

1) The 0.01µF decoupling capacitor should be mounted on the component side of the board as close to the VDD pin as possible. No vias should be used between the decoupling capacitor and VDD pin. The PCB trace to VDD pin should be kept as short as possible, as should the PCB trace to the ground via.

2) To minimize EMI, the 27Ω series termination resistor (if needed) should be placed close to the clock output.

3) An optimum layout is one with all components on the same side of the board, minimizing vias through other signal layers. Other signal traces should be routed away from the ICS7151. This includes signal traces just underneath the device, or on layers adjacent to the ground plane layer used by the device.

Crystal Information

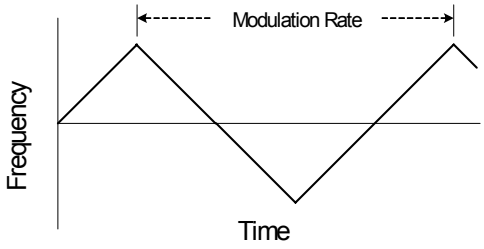
The crystal used should be a fundamental mode (do not use third overtone), parallel resonant. Crystal capacitors should be connected from pins X1 to ground and X2 to ground to optimize the initial accuracy. The value of these capacitors is given by the following equation:

$$\text{Crystal caps (pF)} = (C_L - 6) \times 2$$

In the equation, C_L is the crystal load capacitance. So, for a crystal with a 16 pF load capacitance, two 20 pF [(16-6) x 2] capacitors should be used.

Spread Spectrum Profile

The ICS7151 low EMI clock generator uses a triangular frequency modulation profile for optimal down stream tracking of zero delay buffers and other PLL devices. The frequency modulation amplitude is constant with variations of the input frequency.



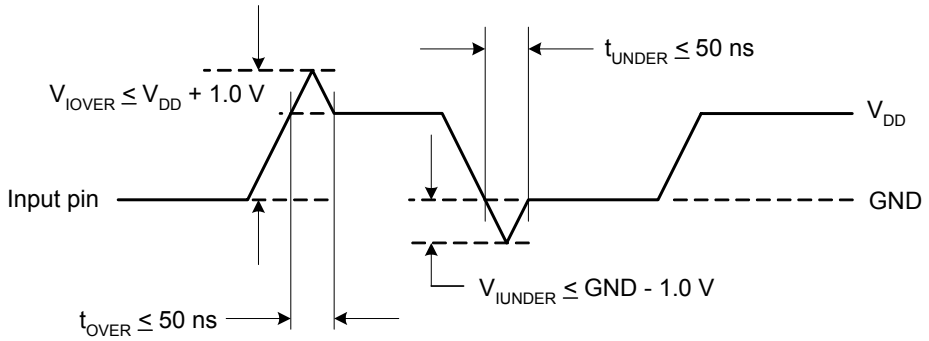
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Absolute Maximum Ratings

Stresses above the ratings listed below can cause permanent damage to the ICS7151. These ratings, which are standard values for ICS 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 (referenced to GND)	-0.5 V to VDD+0.5 V
Ambient Operating Temperature	-40 to +85°C
Storage Temperature	-55 to +125°C
Junction Temperature	-40 to +125°C
Soldering Temperature	260°C
Overshoot (V_{IOVER})	VDD + 1.0 V ($t_{OVER} \leq 50$ ns)
Undershoot (V_{IUNDER})	GND - 1.0 V ($t_{UNDER} \leq 50$ ns)

Overshoot/Undershoot



Recommended Operation Conditions

Parameter	Min.	Typ.	Max.	Units
Ambient Operating Temperature	-40		+85	°C
Power Supply Voltage (measured in respect to GND)	+3.0	3.3	3.6	V

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DC Electrical Characteristics

Unless stated otherwise, **VDD = 3.3 V ±0.3 V**, Ambient Temperature -40 to +85°C

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Operating Voltage	VDD		3.0	3.3	3.6	V
Supply Current	IDD	No load, at 3.3 V		10	20	mA
Input High Voltage	V_{IH}	XIN, S0, S1, ENS	VDDx0.8		VDD + 0.3	V
Input Low Voltage	V_{IL}	XIN, S0, S1, ENS	0.0		VDDx0.20	V
Output High Voltage	V_{OH}	CKOUT, I_{OH} = -4 mA	2.0			V
Output Low Voltage	V_{OL}	CKOUT, I_{OL} = 4 mA			0.4	V
Input Capacitance	C_{IN}	XIN, S0, S1, ENS			16	pF
Load Capacitance	C_L	CKOUT, 8.3 to 66.7 MHz			15	pF
		CKOUT, 66.7 to 100 MHz			10	pF
		CKOUT, 100 to 133.4 MHz			7	pF
Input Pull-up Resistor	R_{PU}	ENS	100	240	400	kΩ

AC Electrical Characteristics

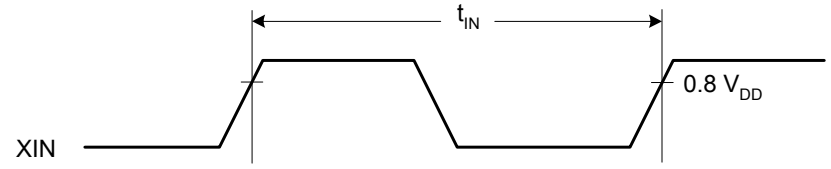
Unless stated otherwise, **VDD = 3.3 V ±0.3 V**, Ambient Temperature -40 to +85° C

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Input Crystal Frequency			16.5		33.4	MHz
Input Clock Frequency	f_{IN}		16.5		33.4	MHz
Output Frequency	f_{OUT}	CKOUT, Multiply by 1 (ICS7151-10)	16.5		33.4	MHz
		CKOUT, Multiply by 2 (ICS7151-20)	33.3		66.7	MHz
		CKOUT, Multiply by 4 (ICS7151-40)	66.6		133.4	MHz
		CKOUT, 2-frequency division (ICS7151-50)	8.3		16.7	MHz
Input Clock Duty Cycle		XIN, 16.5 to 33.4 MHz	40	50	60	%
Output Clock Duty Cycle	t_{DCC}	CKOUT, 1.5 V	40		60	%
Output Slew Rate		CKOUT, 0.4 to 2.4 V, CL = 15 pF	0.5		3.0	V/ns

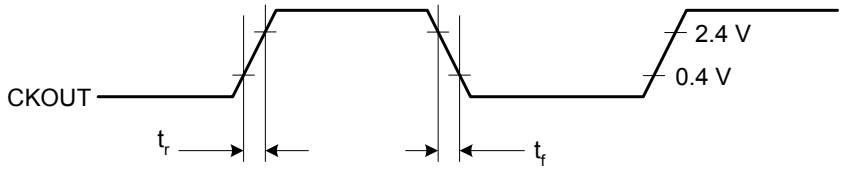
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Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Cycle to Cycle Jitter	t_{JC}	No load, spread off (ICS7151-10, -20)			100	ps
		No load, spread off (ICS7151-40)			150	ps
		No load, spread off (ICS7151-50)			200	ps
Power-up Time		PLL lock-time from power-up to 1% of final value		2	5	ms
Modulation Frequency	f_{MOD}	CKOUT		33		kHz

Input Frequency ($f_{IN} = 1/t_{IN}$)



Output Slew Rate



SR = (2.4 - 0.4) /t_r, SR = (2.4 - 0.4) /t_f

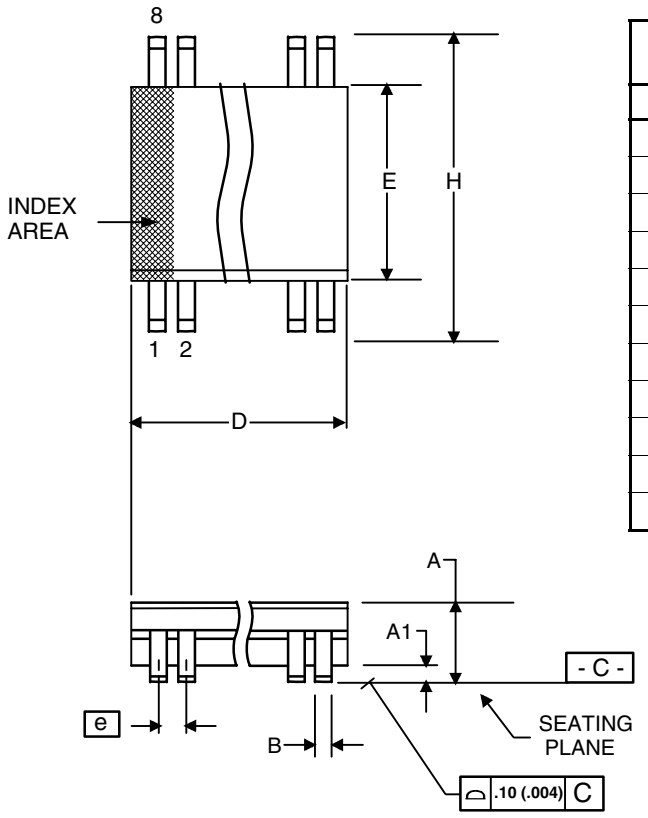
Thermal Characteristics 8 SOIC

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Thermal Resistance Junction to Ambient	θ_{JA}	Still air		150		°C/W
	θ_{JA}	1 m/s air flow		140		°C/W
	θ_{JA}	3 m/s air flow		120		°C/W
Thermal Resistance Junction to Case	θ_{JC}			40		°C/W

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Package Outline and Package Dimensions (8-pin SOIC, 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	.0532	.0688
A1	0.10	0.25	.0040	.0098
B	0.33	0.51	.013	.020
C	0.19	0.25	.0075	.0098
D	4.80	5.00	.1890	.1968
E	3.80	4.00	.1497	.1574
e	1.27 BASIC		0.050 BASIC	
H	5.80	6.20	.2284	.2440
h	0.25	0.50	.010	.020
L	0.40	1.27	.016	.050
α	0°	8°	0°	8°

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Ordering Information

Part / Order Number	Marking	Shipping Packaging	Package	Temperature
ICS7151M-10	7151M-10	Tubes	8-pin SOIC	0 to +70° C
ICS7151M-10T	7151M-10	Tape and Reel	8-pin SOIC	0 to +70° C
ICS7151M-10LF	7151M10L	Tubes	8-pin SOIC	0 to +70° C
ICS7151M-10LFT	7151M10L	Tape and Reel	8-pin SOIC	0 to +70° C
ICS7151M-20	7151M-20	Tubes	8-pin SOIC	0 to +70° C
ICS7151M-20T	7151M-20	Tape and Reel	8-pin SOIC	0 to +70° C
ICS7151M-20LF	7151M20L	Tubes	8-pin SOIC	0 to +70° C
ICS7151M-20LFT	7151M20L	Tape and Reel	8-pin SOIC	0 to +70° C
ICS7151M-40	7151M-40	Tubes	8-pin SOIC	0 to +70° C
ICS7151M-40T	7151M-40	Tape and Reel	8-pin SOIC	0 to +70° C
ICS7151M-40LF	7151M40L	Tubes	8-pin SOIC	0 to +70° C
ICS7151M-40LFT	7151M40L	Tape and Reel	8-pin SOIC	0 to +70° C
ICS7151M-50	7151M-50	Tubes	8-pin SOIC	0 to +70° C
ICS7151M-50T	7151M-50	Tape and Reel	8-pin SOIC	0 to +70° C
ICS7151M-50LF	7151M50L	Tubes	8-pin SOIC	0 to +70° C
ICS7151M-50LFT	7151M50L	Tape and Reel	8-pin SOIC	0 to +70° C
ICS7151MI-10	7151MI10	Tubes	8-pin SOIC	-40 to +85° C
ICS7151MI-10T	7151MI10	Tape and Reel	8-pin SOIC	-40 to +85° C
ICS7151MI-10LF	51MI10LF	Tubes	8-pin SOIC	-40 to +85° C
ICS7151MI-10LFT	51MI10LF	Tape and Reel	8-pin SOIC	-40 to +85° C
ICS7151MI-20	7151MI20	Tubes	8-pin SOIC	-40 to +85° C
ICS7151MI-20T	7151MI20	Tape and Reel	8-pin SOIC	-40 to +85° C
ICS7151MI-20LF	51MI20LF	Tubes	8-pin SOIC	-40 to +85° C
ICS7151MI-20LFT	51MI20LF	Tape and Reel	8-pin SOIC	-40 to +85° C
ICS7151MI-40	7151MI40	Tubes	8-pin SOIC	-40 to +85° C
ICS7151MI-40T	7151MI40	Tape and Reel	8-pin SOIC	-40 to +85° C
ICS7151MI-40LF	51MI40LF	Tubes	8-pin SOIC	-40 to +85° C
ICS7151MI-40LFT	51MI40LF	Tape and Reel	8-pin SOIC	-40 to +85° C
ICS7151MI-50	7151MI50	Tubes	8-pin SOIC	-40 to +85° C
ICS7151MI-50T	7151MI50	Tape and Reel	8-pin SOIC	-40 to +85° C
ICS7151MI-50LF	51MI50LF	Tubes	8-pin SOIC	-40 to +85° C
ICS7151MI-50LFT	51MI50LF	Tape and Reel	8-pin SOIC	-40 to +85° C

Parts that are ordered with a "LF" suffix to the part number are the Pb-Free configuration and are RoHS compliant.

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