

# SPREAD SPECTRUM CLOCK GENERATOR

**ICS7152**

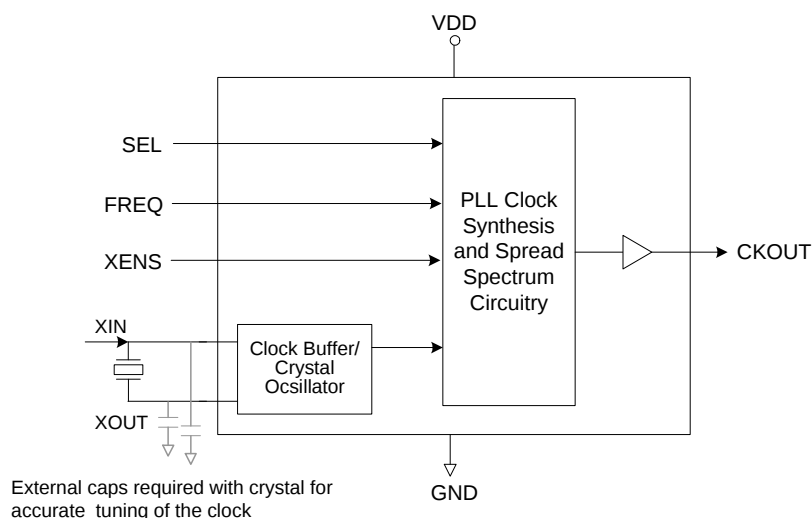
## Description

The ICS7152-01, -02, -11, and -12 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. Center spread maintains an average frequency equal to an unspread clock. Down spread meets maximum frequency specs over the entire modulation cycle.

## Features

- Operating voltage of 3.3 V  $\pm$ 0.3 V
- Packaged in 8-pin SOIC
- Input frequency range of 16.6 to 134.0 MHz
- Output frequency range of 16.6 to 134.0 MHz
- Provides a spread spectrum clock output ( $\pm$ 0.5%,  $\pm$ 1.5% center spread; -1.0%, -3.0% down spread)
- Advanced, low-power CMOS process
- Industrial temperature range available
- Pb (lead) free package, RoHS compliant

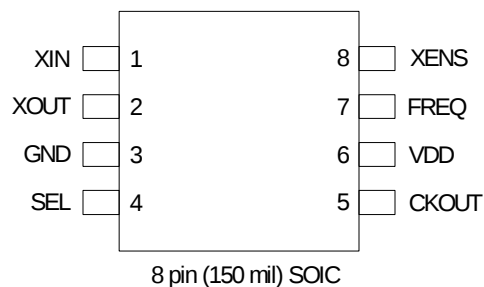
## Block Diagram



## Product Lineup

| Product                   | Input Frequency Range | Modulation Type | Modulation Enable Pin |
|---------------------------|-----------------------|-----------------|-----------------------|
| ICS7152M-01, ICS7152MI-01 | 16.6 MHz to 67 MHz    | Down spread     | Yes                   |
| ICS7152M-02, ICS7152MI-02 | 40.0 MHz to 134.0 MHz |                 |                       |
| ICS7152M-11, ICS7152MI-11 | 16.6 MHz to 67.0 MHz  | Center spread   |                       |
| ICS7152M-12, ICS7152MI-12 | 40.0 MHz to 134.0 MHz |                 |                       |

## Pin Assignment



## SEL Modulation Rate Setting Table

| SEL Pin 4 (note1) | Spread Direction | Spread Percentage (%) | Part Number              |
|-------------------|------------------|-----------------------|--------------------------|
| 0                 | Center           | ±0.5                  | ICS7152M-11, ICS7152M-12 |
|                   | Down             | -1.0                  | ICS7152M-01, ICS7152M-02 |
| 1                 | Center           | ±1.5                  | ICS7152M-11, ICS7152M-12 |
|                   | Down             | -3.0                  | ICS7152M-01, ICS7152M-02 |

## Modulation Enable Setting Table

| XENS Pin 8 | Spread Spectrum |
|------------|-----------------|
| 0          | ON              |
| 1          | OFF             |

## Frequency Setting Table

| FREQ Pin 7 | Frequency      |                          |
|------------|----------------|--------------------------|
| 0          | 16.6 to 40 MHz | ICS7152M-01, ICS7152M-11 |
|            | 40 to 80 MHz   | ICS7152M-02, ICS7152M-12 |
| 1          | 33 to 67 MHz   | ICS7152M-01, ICS7152M-11 |
|            | 66 to 134 MHz  | ICS7152M-02, ICS7152M-12 |

## Pin Descriptions

| Pin Number | Pin Name | Pin Type | Pin Description                                   |
|------------|----------|----------|---------------------------------------------------|
| 1          | XIN      | Input    | Crystal resonator connection pin/clock input pin. |
| 2          | XOUT     | Output   | Crystal resonator connection pin.                 |
| 3          | GND      | Power    | Connect to ground.                                |
| 4          | SEL      | Input    | Modulation rate setting pin.                      |
| 5          | CKOUT    | Output   | Modulated clock output pin.                       |
| 6          | VDD      | Power    | Connect to +3.3 V.                                |
| 7          | FREQ     | Input    | Frequency setting pin.                            |
| 8          | XENS     | Input    | Modulation enable setting pin.                    |

## External Components

The ICS7152 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 6, 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) 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 ICS7152. This includes signal traces just underneath the device, or on layers adjacent to the ground plane layer used by the device.

## Crystal Information

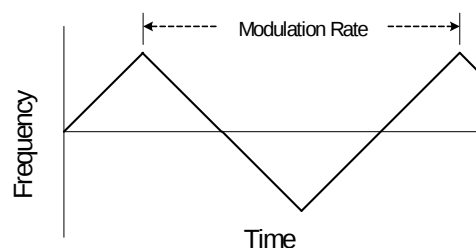
The crystal used should be a fundamental mode, parallel resonant. Crystal capacitors should be connected from pins X1 to ground and X2 to ground to optimize the initial accuracy. The value of these capacitors is given by the following equation:

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

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

## Spread Spectrum Profile

The ICS7152 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.

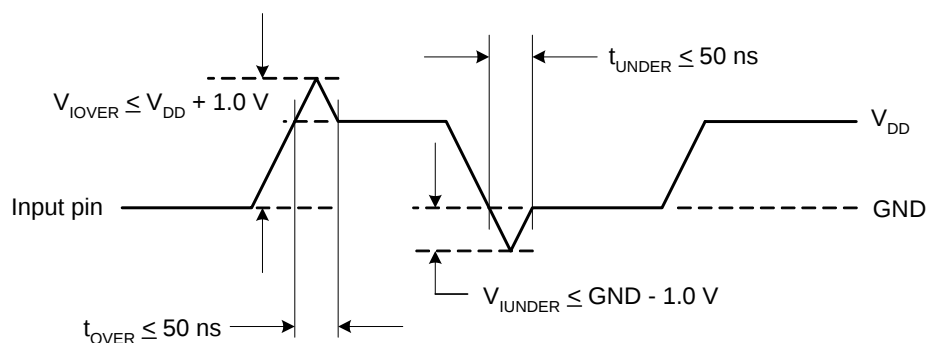


## Absolute Maximum Ratings

Stresses above the ratings listed below can cause permanent damage to the ICS7152. 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 (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) max  |
| Undershoot ( $V_{IUNDER}$ )                | GND - 1.0 V ( $t_{UNDER} \leq 50$ ns) min |

### 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     |

## DC Electrical Characteristics

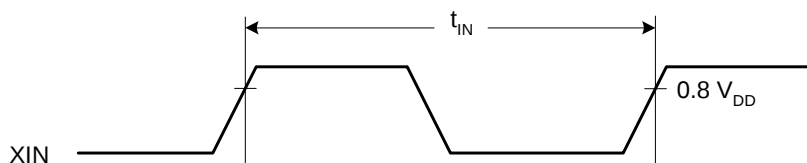
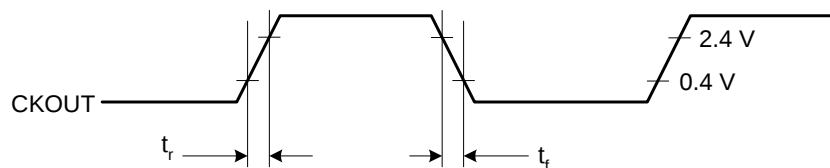
Unless stated otherwise, **VDD = 3.3 V ±0.3 V**, Ambient Temperature -40 to +85°C

| 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                                  |           | 14   | 28         | mA    |
| Input High Voltage  | V <sub>IH</sub> | SEL, FREQ, XENS                                    | VDD x 0.8 |      | VDD + 0.3  | V     |
|                     |                 | XIN, Input slew rate<br>3 V/ns, 16.6 to 100<br>MHz | VDD x 0.8 |      | VDD + 0.3  | V     |
|                     |                 | XIN, Input slew rate<br>3 V/ns, 100 to 134<br>MHz  | VDD x 0.9 |      | VDD + 0.3  | V     |
| Input Low Voltage   | V <sub>IL</sub> | SEL, FREQ, XENS                                    | GND       |      | VDD x 0.20 | V     |
|                     |                 | XIN, Input slew rate<br>3 V/ns, 16.6 to 100<br>MHz | GND       |      | VDD x 0.20 | V     |
|                     |                 | XIN, Input slew rate<br>3 V/ns, 100 to 134<br>MHz  | GND       |      | VDD x 0.10 | V     |
| Output High Voltage | V <sub>OH</sub> | CKOUT, I <sub>OH</sub> = -4 mA                     | VDD - 0.5 |      | VDD        | V     |
| Output Low Voltage  | V <sub>OL</sub> | CKOUT, I <sub>OL</sub> = 4 mA                      | GND       |      | 0.4        | V     |
| Input Capacitance   | C <sub>IN</sub> | XIN, SEL, XENS                                     |           |      | 16         | pF    |
| Load Capacitance    | C <sub>L</sub>  | CKOUT, 16.6 to 67<br>MHz                           |           |      | 15         | pF    |
|                     |                 | CKOUT, 67 to 100<br>MHz                            |           |      | 10         | pF    |
|                     |                 | CKOUT, 100 to 134<br>MHz                           |           |      | 7          | pF    |
| Output Impedance    | Z <sub>O</sub>  | CKOUT, 16.6 to 134<br>MHz                          |           | 25   |            | Ω     |

## AC Electrical Characteristics

Unless stated otherwise,  $V_{DD} = 3.3\text{ V} \pm 0.3\text{ V}$ , Ambient Temperature  $-40$  to  $+85^{\circ}\text{ C}$

| Parameter               | Symbol    | Conditions                                                          | Min. | Typ. | Max. | Units |
|-------------------------|-----------|---------------------------------------------------------------------|------|------|------|-------|
| Input Crystal Frequency |           |                                                                     | 16.6 |      | 40   | MHz   |
| Input Clock Frequency   | $f_{IN}$  | ICS7152-01, -11                                                     | 16.6 |      | 67   | MHz   |
|                         |           | ICS7152-02, -12                                                     | 40   |      | 134  | MHz   |
| Output Frequency        | $f_{OUT}$ | CKOUT,<br>ICS7152-01, -11                                           | 16.6 |      | 67   | MHz   |
|                         |           | CKOUT,<br>ICS7152-02, -12                                           | 40   |      | 134  | MHz   |
| Input Clock Duty Cycle  | $t_{DCI}$ | XIN, 16.6 to 100 MHz                                                | 40   | 50   | 60   | %     |
|                         |           | XIN, 100 to 134 MHz                                                 | 45   | 50   | 55   | %     |
| Output Clock Duty Cycle | $t_{DCC}$ | CKOUT, 1.5 V                                                        | 40   |      | 60   | %     |
| Output Slew Rate        |           | CKOUT, 0.4 to 2.4 V, $CL = 15\text{ pF}$                            | 0.5  |      | 3.0  | V/ns  |
| Cycle-to-Cycle Jitter   | $t_{JC}$  | No load, spread off,<br>ICS7152-01, -02                             |      |      | 150  | ps    |
|                         |           | No load, spread off,<br>ICS7152-11, -12                             |      |      | 250  |       |
|                         |           | No load, spread off,<br>ICS7152-01, 33.33 MHz,<br>SEL = 0, FREQ = 1 |      |      | 120  |       |
| Power-up Time           |           | PLL lock-time from power-up<br>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**

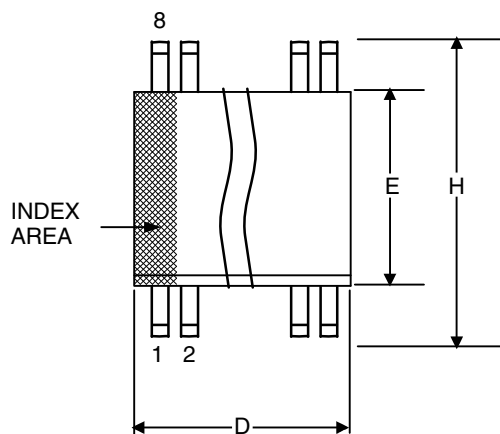
$$SR = (2.4 - 0.4) / t_r, SR = (2.4 - 0.4) / t_f$$

**Thermal Characteristics 8 SOIC**

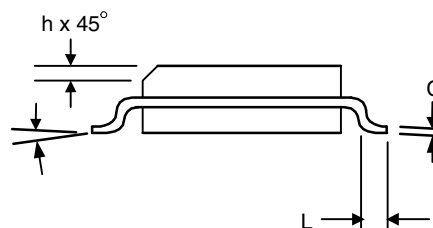
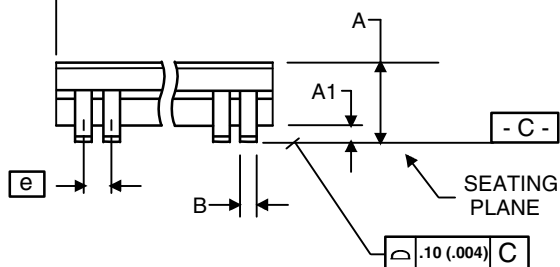
| Parameter                              | Symbol        | Conditions     | Min. | Typ. | Max. | Units |
|----------------------------------------|---------------|----------------|------|------|------|-------|
| Thermal Resistance Junction to Ambient | $\theta_{JA}$ | Still air      |      | 150  | 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

## Package Outline and Package Dimensions (8-pin SOIC, 150 Mil. Body)

Package dimensions are kept current with JEDEC Publication No. 95



| Symbol   | Millimeters |      | Inches      |       |
|----------|-------------|------|-------------|-------|
|          | 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  |
| $\alpha$ | 0°          | 8°   | 0°          | 8°    |



## Ordering Information

| Part / Order Number | Marking  | Shipping Packaging | Package    | Temperature   |
|---------------------|----------|--------------------|------------|---------------|
| 7152M-01LF          | 52M-01LF | Tubes              | 8-pin SOIC | 0 to +70° C   |
| 7152M-01LFT         | 52M-01LF | Tape and Reel      | 8-pin SOIC | 0 to +70° C   |
| 7152MI-01LF         | 52MI01LF | Tubes              | 8-pin SOIC | -40 to +85° C |
| 7152MI-01LFT        | 52MI01LF | Tape and Reel      | 8-pin SOIC | -40 to +85° C |
| 7152M-02LF          | 7152M02L | Tubes              | 8-pin SOIC | 0 to +70° C   |
| 7152M-02LFT         | 7152M02L | Tape and Reel      | 8-pin SOIC | 0 to +70° C   |
| 7152MI-02LF         | 52MI02LF | Tubes              | 8-pin SOIC | -40 to +85° C |
| 7152MI-02LFT        | 52MI02LF | Tape and Reel      | 8-pin SOIC | -40 to +85° C |
| 7152M-11LF          | 7152M11L | Tubes              | 8-pin SOIC | 0 to +70° C   |
| 7152M-11LFT         | 7152M11L | Tape and Reel      | 8-pin SOIC | 0 to +70° C   |
| 7152MI-11LF         | 52MI11LF | Tubes              | 8-pin SOIC | -40 to +85° C |
| 7152MI-11LFT        | 52MI11LF | Tape and Reel      | 8-pin SOIC | -40 to +85° C |
| 7152M-12LF          | 52M-12LF | Tubes              | 8-pin SOIC | 0 to +70° C   |
| 7152M-12LFT         | 52M-12LF | Tape and Reel      | 8-pin SOIC | 0 to +70° C   |
| 7152MI-12LF         | 52MI12LF | Tubes              | 8-pin SOIC | -40 to +85° C |
| 7152MI-12LFT        | 52MI12LF | Tape and Reel      | 8-pin SOIC | -40 to +85° C |

**"LF" suffix to the part number are the Pb-Free configuration and are RoHS compliant.**

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