



**THE DATASHEET OF  
MK5812S**



# LOW EMI CLOCK GENERATOR

# MK5812

## Description

The MK5812 device generates a low EMI output clock from a clock or crystal input. The device is designed to dither a high emissions clock to lower EMI in consumer applications. Using IDT's proprietary mix of analog and digital Phase-Locked Loop (PLL) technology, the device spreads the frequency spectrum of the output and reduces the frequency amplitude peaks by several dB. The MK5812 offers both centered and down spread from a high-speed clock input. The multiplier is a fixed 2x.

For different multiplier configurations, use the MK5811 (1x) or MK5814 (4x).

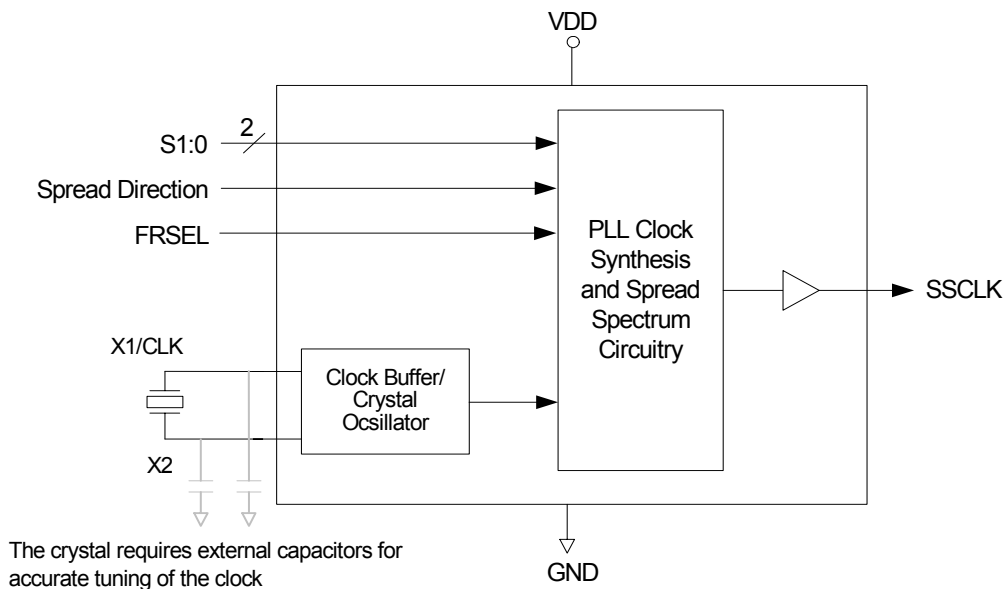
IDT offers many other clocks for computers and computer peripherals. Consult IDT when you need to remove crystals and oscillators from your board.

## Features

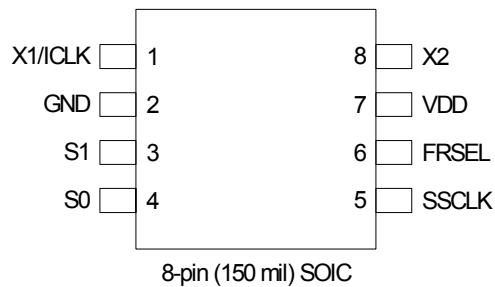
- Packaged in 8-pin SOIC
- Provides a spread spectrum output clock
- Supports flat panel controllers
- Accepts a clock or crystal input (provides same frequency dithered output)
- Input frequency range of 4 to 32 MHz
- Output frequency range of 8 to 64 MHz
- 2X frequency multiplication
- Center and down spread
- Peak reduction by 8 dB to 16 dB typical on 3rd through 19th odd harmonics
- Low EMI feature can be disabled
- Includes power down
- Operating voltage of 3.3 V
- Advanced, low-power CMOS process

**NOTE: EOL for non-green parts to occur on 5/13/10 per PDN U-09-01**

## Block Diagram



## Pin Assignment



## Spread Direction and Spread Percentage

| S1<br>Pin 3 | S0<br>Pin 4 | Spread<br>Direction | Spread<br>Percentage |
|-------------|-------------|---------------------|----------------------|
| 0           | 0           | Center              | ±1.4                 |
| 0           | M           | Center              | ±1.1                 |
| 0           | 1           | Center              | ±0.6                 |
| M           | 0           | Center              | ±0.5                 |
| M           | M           | No Spread           | -                    |
| M           | 1           | Down                | -1.6                 |
| 1           | 0           | Down                | -2.0                 |
| 1           | M           | Down                | -0.7                 |
| 1           | 1           | Down                | -3.0                 |

0 = connect to GND

M = unconnected (floating)

1 = connect directly to VDD

## Frequency Selection

| Product             | FRSEL<br>(pin 6) | Input<br>Freq. Range | Multiplier | Output<br>Freq. Range |
|---------------------|------------------|----------------------|------------|-----------------------|
| MK5811 <sup>1</sup> | 0                | 4.0 to 8.0 MHz       | X1         | 4.0 to 8.0 MHz        |
|                     | 1                | 8.0 to 16.0MHz       | X1         | 8.0 to 16.0MHz        |
|                     | M                | 16.0 to 32.0MHz      | X1         | 16.0 to 32.0MHz       |
| MK5812              | 0                | 4.0 to 8.0 MHz       | X2         | 8.0 to 16.0MHz        |
|                     | 1                | 8.0 to 16.0MHz       | X2         | 16.0 to 32.0MHz       |
|                     | M                | 16.0 to 32.0MHz      | X2         | 32.0 to 64.0MHz       |
| MK5814 <sup>1</sup> | 0                | 4.0 to 8.0 MHz       | X4         | 16.0 to 32.0MHz       |
|                     | 1                | 8.0 to 16.0MHz       | X4         | 32.0 to 64.0MHz       |
|                     | M                | 16.0 to 32.0MHz      | X4         | 64.0 to 128MHz        |

0 = connect to GND

M = unconnected (floating)

1 = connect directly to VDD

Note 1: The information in this datasheet does not apply to the MK5811 and MK5814 as each have independent datasheets available at [www.icst.com](http://www.icst.com).

## Pin Descriptions

| Pin Number | Pin Name | Pin Type | Pin Description   |
|------------|----------|----------|---|
| 1          | X1/ICLK  | Input    | Connect to 4-32 MHz crystal or clock.   |
| 2          | GND      | Power    | Connect to ground.  |
| 3          | S1       | Input    | Function select 1 input. Selects spread amount and direction per table above. (default-internal mid-level). |
| 4          | S0       | Input    | Function select 0 input. Selects spread amount and direction per table above. (default-internal mid-level). |
| 5          | SSCLK    | Output   | Clock output with Spread spectrum   |
| 6          | FRSEL    | Input    | Function select for input frequency range. Default to mid level "M".  |
| 7          | VDD      | Power    | Connect to +3.3 V.  |
| 8          | X2       | XO       | Crystal connection to 4-32 MHz crystal. Leave unconnected for clock   |

## External Components

The MK5812 requires a minimum number of external components for proper operation.

### Decoupling Capacitor

A decoupling capacitor of 0.01 $\mu$ F must be connected between VDD and GND on pins 7 and 2. Connect the capacitor as close to these pins as possible. For optimum device performance, mount the decoupling capacitor on the component side of the PCB. Avoid the use of vias in the decoupling circuit.

### Series Termination Resistor

Use series termination when the PCB trace between the clock output and the load is over 1 inch. To series terminate a 50 $\Omega$  trace (a commonly used trace impedance), place a 33 $\Omega$  resistor in series with the clock line. Place the resistor as close to the clock output pin as possible. The nominal impedance of the clock output is 20 $\Omega$ .

### Tri-level Select Pin Operation

The S1 and S0 select pins are tri-level, meaning that they have three separate states to make the selections shown in the table on page 2. To select the M (mid) level, the connection to these pins must be eliminated by either floating them originally, or tri-stating the GPIO pins which drive the select pins.

## PCB Layout Recommendations

For optimum device performance and lowest output phase noise, observe the following guidelines:

- 1) Mount the 0.01 $\mu$ F decoupling capacitor 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 the VDD pin and the PCB trace to the ground via should be kept as short as possible.
- 2) To minimize EMI, place the 33 $\Omega$  series-termination resistor (if needed) close to the clock output.
- 3) An optimum layout is one with all components on the same side of the board, thus minimizing vias through other signal layers. Other signal traces should be routed away from the MK5812 device. This includes signal traces located underneath the device, or on layers adjacent to the ground plane layer used by the device.

## Crystal Information

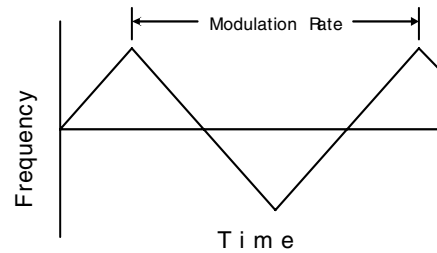
The crystal used should be a fundamental mode (do not use third overtone), parallel resonant crystal. To optimize the initial accuracy, connect crystal capacitors from pins X1 to ground and X2 to ground. The value of these capacitors is given by the following equation:

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

In the equation,  $C_L$  is the crystal load capacitance. For example, a crystal with a 16 pF load capacitance uses two 20 pF [(16-6) x 2] capacitors.

### Spread Spectrum Profile

The MK5812 is a low EMI clock generator using an optimized frequency slew rate algorithm to facilitate down stream tracking of zero delay buffers and other PLL devices.



### Absolute Maximum Ratings

Stresses above the ratings listed below can cause permanent damage to the MK5812. 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 +85° 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    |      | +85  | °C    |
| Power Supply Voltage (measured in respect to GND) | +3.0 |      | 3.63 | V     |

## DC Electrical Characteristics

Unless stated otherwise,  $V_{DD} = 3.3\text{ V} \pm 10\%$ , Ambient Temperature 0 to  $+85^\circ\text{C}$

| Parameter            | Symbol           | Conditions                    | Min.    | Typ.   | Max.    | Units |
|----------------------|------------------|-------------------------------|---------|--------|---------|-------|
| Operating Voltage    | VDD              |                               | 3.0     | 3.3    | 3.63    | V     |
| Supply Current       | IDD              | No load, at 3.3 V, Fin=12 MHz |         | 13     | 25      | mA    |
|                      |                  | No load, at 3.3 V, Fin=24 MHz |         |        | 30      | mA    |
|                      |                  | No load, at 3.3 V, Fin=32 MHz |         |        | 35      | mA    |
| Input High Voltage   | V <sub>IH</sub>  |                               | 0.85VDD | VDD    | VDD     | V     |
| Input Middle Voltage | V <sub>IHM</sub> |                               | 0.4VDD  | 0.5VDD | 0.6VDD  | V     |
| Input Low Voltage    | V <sub>IL</sub>  |                               | 0.0     | 0.0    | 0.15VDD | V     |
| Output High Voltage  | V <sub>OH</sub>  | CMOS, I <sub>OH</sub> = -4 mA | 2.4     |        |         | V     |
| Output High Voltage  | V <sub>OH</sub>  | I <sub>OH</sub> = -6 mA       | 2.0     |        |         | V     |
| Output Low Voltage   | V <sub>OL</sub>  | I <sub>OL</sub> = -4 mA       |         |        | 0.4     | V     |
|                      |                  | I <sub>OL</sub> = -10 mA      |         |        | 1.2     | V     |
| Input Capacitance    | C <sub>IN1</sub> | S0, S1, FRSEL pins            |         | 4      | 6       | pF    |
|                      | C <sub>IN2</sub> | X1, X2 pins                   |         | 6      | 9       | pF    |

## AC Electrical Characteristics

Unless stated otherwise,  $V_{DD} = 3.3\text{ V} \pm 10\%$ , Ambient Temperature 0 to  $+85^\circ\text{C}$ , C<sub>L</sub> = 15 pF

| Parameter                          | Symbol         | Conditions              | Min. | Typ.    | Max. | Units |
|------------------------------------|----------------|-------------------------|------|---------|------|-------|
| Input Clock Frequency              |                |                         | 4    |         | 32   | MHz   |
| Output Clock Frequency             |                |                         | 8    |         | 64   | MHz   |
| Input Clock Duty Cycle             |                | Time above VDD/2        | 40   |         | 60   | %     |
| Output Clock Duty Cycle            |                | Time above 1.5 V        | 45   | 50      | 55   | %     |
| Cycle-to-cycle Jitter <sup>1</sup> |                | Fin=8 MHz, Fout=16 MHz  |      | 225     | 400  | ps    |
| Cycle-to-cycle Jitter <sup>1</sup> |                | Fin=16 MHz, Fout=32 MHz |      | 210     | 380  | ps    |
| Output Rise Time                   | t <sub>R</sub> | 0.4 to 2.4 V            | 2.0  |         | 5.0  | ns    |
| Output Fall Time                   | t <sub>F</sub> | 2.4 to 0.4 V            | 2.0  |         | 4.4  | ns    |
| EMI Peak Frequency Reduction       |                |                         |      | 8 to 16 |      | dB    |

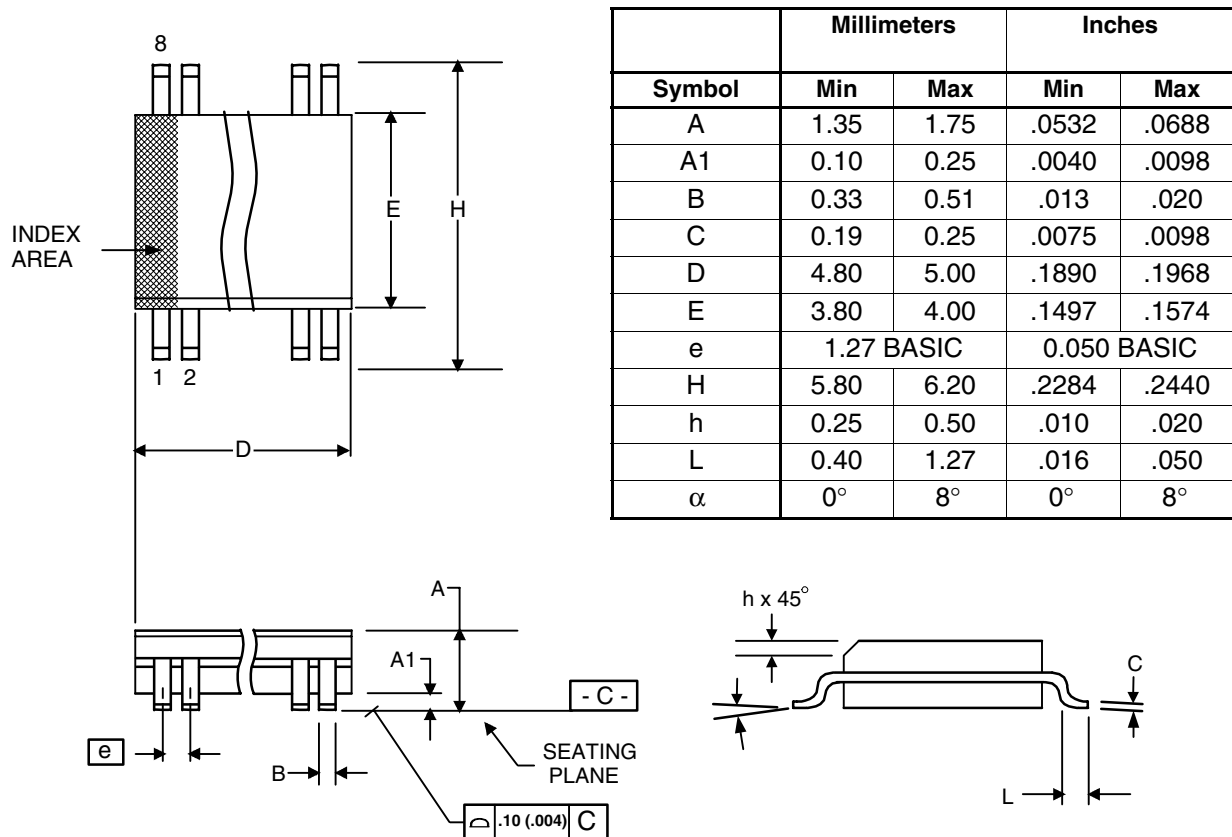
Note 1: Spread is enabled.

## Thermal Characteristics for 8-pin SOIC

| Parameter                              | Symbol          | Conditions     | Min. | Typ. | Max. | Units |
|--|-----------------|----------------|------|------|------|-------|
| Thermal Resistance Junction to Ambient | θ <sub>JA</sub> | Still air      |      | 150  |      | °C/W  |
|  | θ <sub>JA</sub> | 1 m/s air flow |      | 140  |      | °C/W  |
|  | θ <sub>JA</sub> | 3 m/s air flow |      | 120  |      | °C/W  |
| Thermal Resistance Junction to Case    | θ <sub>JC</sub> |                |      | 40   |      | °C/W  |

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

Package dimensions are kept current with JEDEC Publication No. 95



## Ordering Information

| Part / Order Number | Marking | Shipping packaging | Package    | Temperature |
|---------------------|---------|--------------------|------------|-------------|
| MK5812S*            | 5812S   | Tubes              | 8-pin SOIC | 0 to +85° C |
| MK5812STR*          | 5812S   | Tape and Reel      | 8-pin SOIC | 0 to +85° C |
| MK5812SLF           | 5812SL  | Tubes              | 8-pin SOIC | 0 to +85° C |
| MK5812SLFTR         | 5812SL  | Tape and Reel      | 8-pin SOIC | 0 to +85° C |

\*NOTE: EOL for non-green parts to occur on 5/13/10 per PDN U-09-01

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