

Automotive Temperature Range Spread-Spectrum Econoscillator

DS1091L

General Description

The DS1091L is a low-cost clock generator that is factory-trimmed to output frequencies from 130kHz to 66.6MHz with a nominal accuracy of $\pm 0.25\%$. The device can also produce a center- or down-dithered spread-spectrum output with pin-selectable dither magnitude and rate. Assembled in an 8-pin $\mu\text{MAX}^{\text{®}}$ package, the DS1091L is designed to operate with a 3.0V to 3.6V power supply over the automotive temperature range (-40°C to $+125^{\circ}\text{C}$).

Applications

Automotive Infotainment
POS Terminals
LCD Displays
Printers
Industrial Control

Features

- ◆ Spread-Spectrum Clock Output from 130kHz to 66.6MHz
- ◆ Operating Temperature Range of -40°C to $+125^{\circ}\text{C}$
- ◆ Accuracy of $\pm 1.75\%$ Across Temperature and Voltage
- ◆ Factory Trimmed
- ◆ Center-Dithered (DS1091LA) or Down-Dithered (DS1091LB) Spread-Spectrum Output
- ◆ Pin-Selectable Center-Dither Magnitude of 0%, $\pm 1\%$, $\pm 2\%$, or $\pm 4\%$
- ◆ Pin-Selectable Down-Dither Magnitude of 0%, -2% , -4% , or -8%
- ◆ Pin-Selectable Dither Rate
- ◆ 3.0V to 3.6V Supply Operation
- ◆ Lead-Free 8-Pin μMAX Package

Ordering Information

| PART | TEMP RANGE | PIN-PACKAGE | SPREAD SPECTRUM | OUTPUT FREQUENCY (MHz) |
|----------------|---|-------------------|-----------------|--------------------------|
| DS1091LUA-027+ | -40°C to $+125^{\circ}\text{C}$ | 8 μMAX | Center | 27.0 |
| DS1091LUA-033+ | -40°C to $+125^{\circ}\text{C}$ | 8 μMAX | Center | 33.3 |
| DS1091LUA-066+ | -40°C to $+125^{\circ}\text{C}$ | 8 μMAX | Center | 66.6 |
| DS1091LUA-xxx+ | -40°C to $+125^{\circ}\text{C}$ | 8 μMAX | Center | Custom (Contact Factory) |
| DS1091LUB-027+ | -40°C to $+125^{\circ}\text{C}$ | 8 μMAX | Down | 27.0 |
| DS1091LUB-033+ | -40°C to $+125^{\circ}\text{C}$ | 8 μMAX | Down | 33.3 |
| DS1091LUB-066+ | -40°C to $+125^{\circ}\text{C}$ | 8 μMAX | Down | 66.6 |
| DS1091LUB-xxx+ | -40°C to $+125^{\circ}\text{C}$ | 8 μMAX | Down | Custom (Contact Factory) |

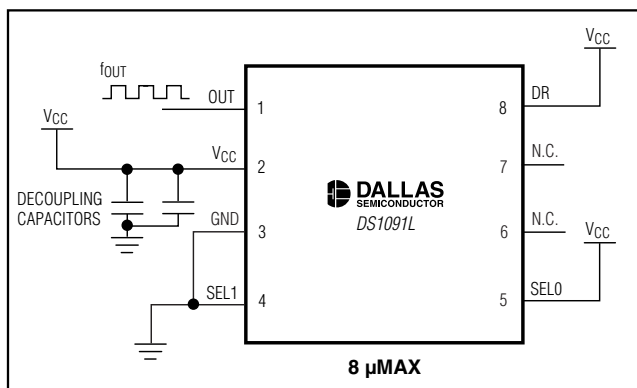
+Denotes lead-free package.

xxx Denotes factory-programmed custom frequencies.

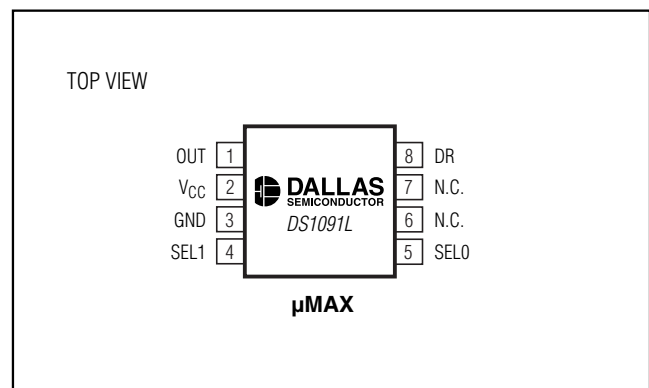
Email Custom_EconOscillators_Info@dalsemi.com for information/questions concerning custom frequencies.

μMAX is a registered trademark of Maxim Integrated Products, Inc.

Typical Operating Circuit



Pin Configuration



Automotive Temperature Range Spread-Spectrum Econoscillator

ABSOLUTE MAXIMUM RATINGS

Voltage on V_{CC} Relative to Ground-0.5V to +6.0V
 Voltage on DR, SEL0, SEL1 Relative
 to Ground*-0.5V to ($V_{CC} + 0.5V$)

Operating Temperature Range-40°C to +125°C
 Storage Temperature Range-55°C to +125°C
 Soldering Temperature.....See J-STD-020 Specification

*This voltage must not exceed 6.0V.

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 in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

RECOMMENDED OPERATING CONDITIONS

($T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$.)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|--|----------|------------|-------------------|-----|-------------------|-------|
| Supply Voltage | V_{CC} | (Note 1) | 3.0 | 3.3 | 3.6 | V |
| High-Level Input Voltage (SEL0, SEL1, DR) | V_{IH} | | 0.7 x V_{CC} | | $V_{CC} +$ 0.3 | V |
| Low-Level Input Voltage (SEL0, SEL1, DR) | V_{IL} | | -0.3 | | 0.3 x V_{CC} | V |

DC ELECTRICAL CHARACTERISTICS

($T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$; $V_{CC} = +3.0V$ to $+3.6V$, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|--|----------|--|-----|-----|-----|---------------|
| High-Level Output Voltage (OUT) | V_{OH} | $I_{OH} = -4\text{mA}$, $V_{CC} = 3.0V$ | 2.4 | | | V |
| Low-Level Output Voltage (OUT) | V_{OL} | $I_{OL} = 4\text{mA}$ | | | 0.4 | V |
| High-Level Input Current (SEL0, SEL1, DR) | I_{IH} | $V_{CC} = 3.6V$ | | | 1 | μA |
| Low-Level Input Current (SEL0, SEL1, DR) | I_{IL} | $V_{IL} = 0$ | -1 | | | μA |
| Supply Current (Active) | I_{CC} | (Note 2) | | | 16 | mA |

AC ELECTRICAL CHARACTERISTICS

($T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$; $V_{CC} = +3.0V$ to $+3.6V$, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|-----------------------------------|------------------|--|-------|-----|-------|-------|
| Output Frequency Range | f_{OUT} | (Note 3) | 0.130 | | 66.6 | MHz |
| Output Center Frequency Tolerance | Δf_{OUT} | $V_{CC} = 3.3V$, $T_A = +25^\circ\text{C}$ | -0.25 | 0 | +0.25 | % |
| | | Across T_A and V_{CC} | -1.75 | | +1.75 | |
| | | 0°C to $+70^\circ\text{C}$, across V_{CC} | -1.2 | | +1.2 | |
| Power-Up Time | t_{PU} | (Note 4) | | | 0.1 | ms |
| Load Capacitance | C_L | | | 15 | 50 | pF |

Automotive Temperature Range Spread-Spectrum Econoscillator

AC ELECTRICAL CHARACTERISTICS (continued)

($T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$; $V_{CC} = +3.0\text{V}$ to $+3.6\text{V}$.)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---------------------|--------|--------------------------------|-----|-----|-----|-------|
| Duty Cycle | | < 33.3MHz (Note 3) | 50 | | | % |
| | | $\geq 33.3\text{MHz}$ (Note 3) | 40 | 60 | | |
| Jitter (RMS), 50MHz | | | 0.3 | | | % |

Note 1: All voltages are referenced to ground. Currents entering the IC are specified positive and currents exiting the IC are negative.

Note 2: Supply current measured with $C_L = 15\text{pF}$, $V_{CC} = 3.6\text{V}$, $T_A = 25^{\circ}\text{C}$, $f_{OUT} = 66.6\text{MHz}$, no dither.

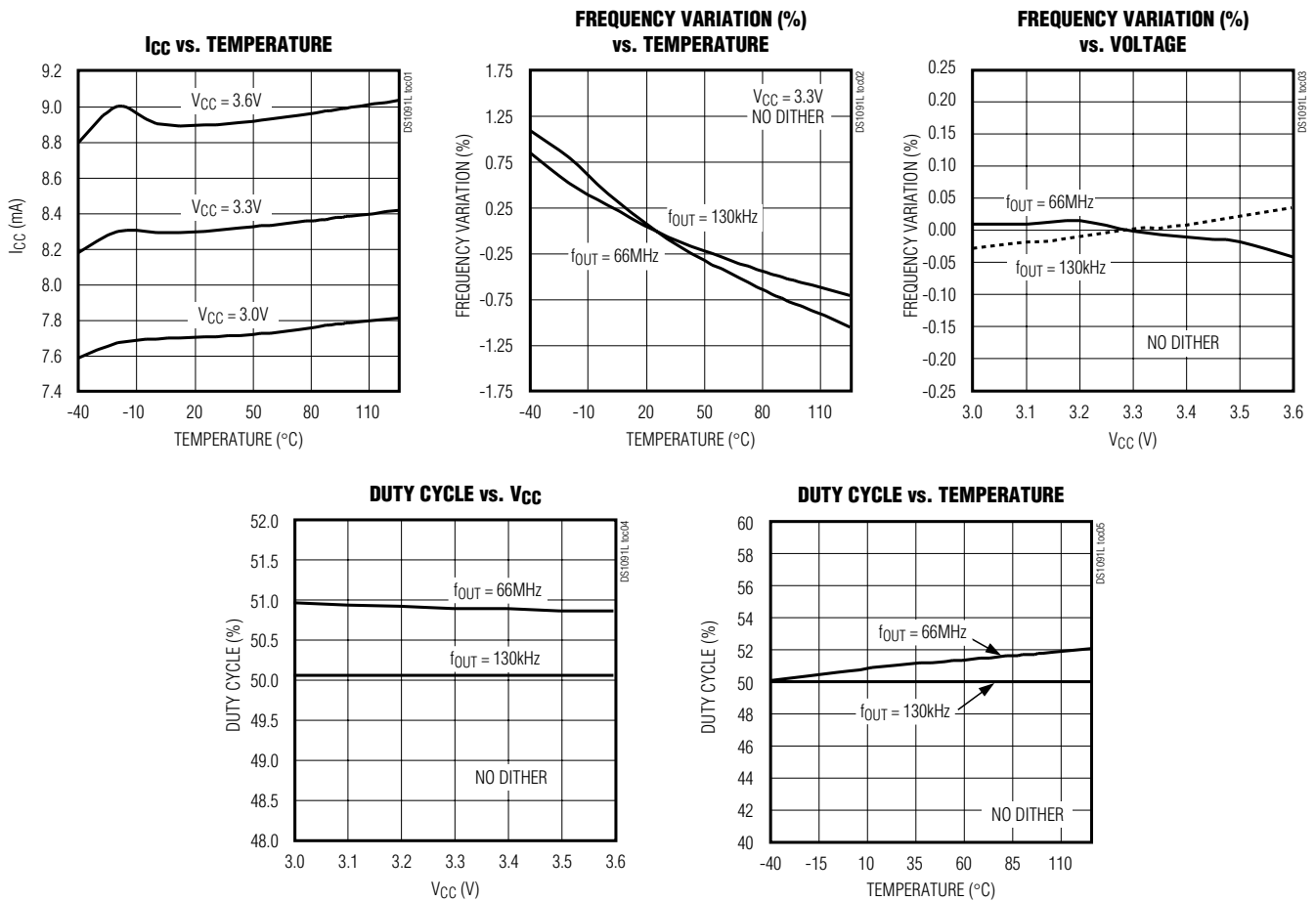
Note 3: No dither.

Note 4: Guaranteed by design.

Note 5: For aging characteristics, contact factory.

Typical Operating Characteristics

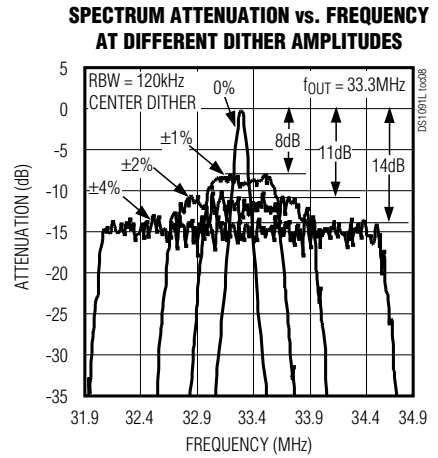
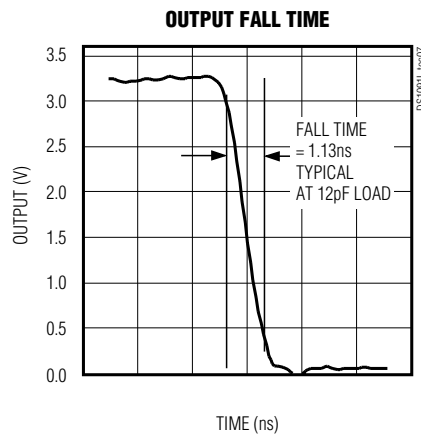
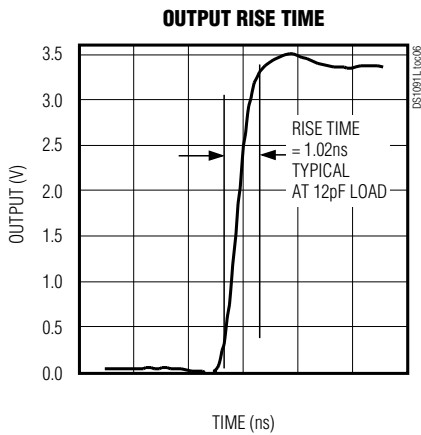
($T_A = +25^{\circ}\text{C}$, $V_{CC} = 3.3\text{V}$, unless otherwise noted.)



Automotive Temperature Range Spread-Spectrum Econoscillator

Typical Operating Characteristics (continued)

(T_A = +25°C, V_{CC} = 3.3V, unless otherwise noted.)



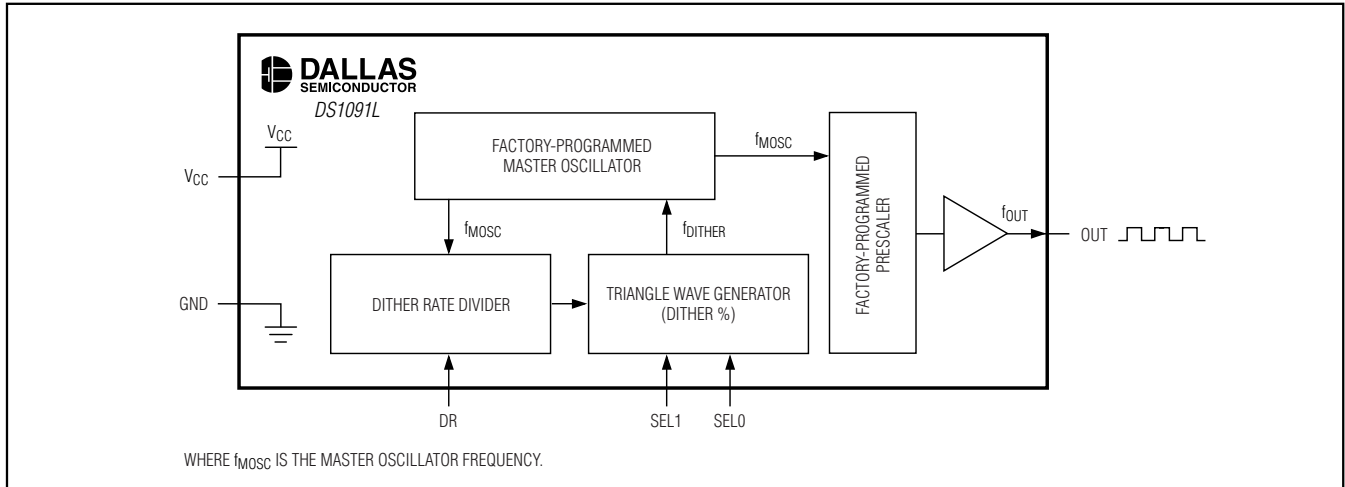
Pin Description

| PIN μMAX8 | NAME | FUNCTION |
|--------------|-----------------|---|
| 1 | OUT | Spread-Spectrum Clock Output |
| 2 | V _{CC} | Supply Voltage |
| 3 | GND | Ground |
| 4 | SEL1 | Spread Spectrum Dither Magnitude Select Inputs. Selects dither magnitude (see Table 1). |
| 5 | SEL0 | |
| 6, 7 | N.C. | No Connection |
| 8 | DR | Spread-Spectrum Dither Rate Selector. Selects dither rate (see Table 2). |

Automotive Temperature Range Spread-Spectrum Econoscillator

Block Diagram

DS1091L



Detailed Description

The DS1091L is a clock generator that is capable of output frequencies from 130kHz to 66.6MHz over the full automotive temperature range (-40°C to +125°C). The device also is capable of producing a spread-spectrum (dithered) square-wave output using four pin-selectable dither percentages. Both center (DS1091LA) and down (DS1091LB) dithering options are available. The device also features two selectable dither rates.

The DS1091L is shipped from the factory programmed to a customer-specified frequency.

Spread Spectrum

The DS1091L has the ability to reduce radiated emission peaks. The dither percentage is controlled by the state of the SEL0 and SEL1 pins. The output frequency can be dithered at 0%, ±1%, ±2%, and ±4%, centered around the programmed frequency (for the DS1091LB this can be down dithered by 0%, -2%, -4%, and -8%).

The two select pins SEL0 and SEL1 provide a means of selecting the dither magnitudes as follows:

A triangle wave generator injects a control signal into the master oscillator to dither its output. The dither rate is a function of the output frequency, f_{OUT} as well as the setting of the DR pin (see the equation below). Figure 1 shows a plot of the output frequency versus time.

$$\text{DITHER RATE} = \frac{f_{OUT}}{2^n}$$

where n is defined in Table 2 as a function of output frequency. For example, for an output frequency of 27.0MHz, the dither rate would be 13.2kHz for DR = 0 and 6.6kHz for DR = 1.

Table 1.

| SEL1 LOGIC LEVEL | SEL0 LOGIC LEVEL | DITHER MAGNITUDE | |
|---------------------|---------------------|------------------|-----------|
| | | DS1091LA | DS1091LB |
| 0 | 0 | No Dither | No Dither |
| 0 | 1 | ±1% | -2% |
| 1 | 0 | ±2% | -4% |
| 1 | 1 | ±4% | -8% |

Table 2.

| OUTPUT FREQUENCY f_{OUT} (MHz) | | n | |
|-------------------------------------|-----------------|-----------------------|-----------------------|
| f_{OUT} (min) | f_{OUT} (max) | DR = LOGIC LEVEL 1 | DR = LOGIC LEVEL 0 |
| 0.130 | 0.260 | 4 | 5 |
| 0.261 | 0.521 | 5 | 6 |
| 0.522 | 1.042 | 6 | 7 |
| 1.043 | 2.083 | 7 | 8 |
| 2.084 | 4.167 | 8 | 9 |
| 4.168 | 8.333 | 9 | 10 |
| 8.334 | 16.667 | 10 | 11 |
| 16.668 | 33.333 | 11 | 12 |
| 33.334 | 66.667 | 12 | 13 |

Automotive Temperature Range Spread-Spectrum Econoscillator

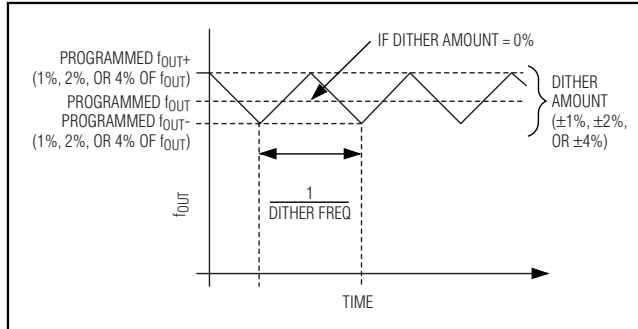


Figure 1A. Center Dithered

Power-Up

Upon the application of power, the DS1091L output is held in the low state until t_{PU} has elapsed. This removes any possibility of erroneous output transitions during initial power-up.

DS1091L Frequency Spreading Profile as a Function of Dither %

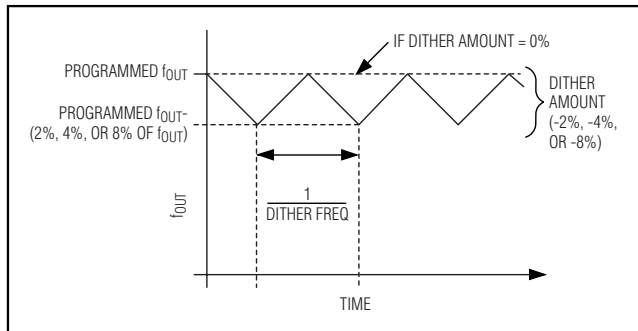


Figure 1B. Down Dithered

Application Information

Power-Supply Decoupling

To achieve best results, it is highly recommended that decoupling capacitors are used on the IC power-supply pins. Typical values of decoupling capacitors are 0.01 μ F and 0.1 μ F. Use a high-quality, ceramic, surface-mount capacitor, and mount it as close as possible to the VCC and GND pins of the IC to minimize lead inductance.

Requesting Custom Frequencies

Email Custom_EconOscillators_Info@dalsemi.com for information/questions concerning custom frequencies.

Chip Topology

TRANSISTOR COUNT: 4887

SUBSTRATE CONNECTED TO GROUND

Package Information

For the latest package outline information, go to www.maxim-ic.com/DallasPackInfo.

Revision History

Pages changed at Rev 1: 1, 6.

Maxim cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Maxim product. No circuit patent licenses are implied. Maxim reserves the right to change the circuitry and specifications without notice at any time.

6 **Maxim Integrated Products, 120 San Gabriel Drive, Sunnyvale, CA 94086 408-737-7600**

© 2007 Maxim Integrated Products

MAXIM is a registered trademark of Maxim Integrated Products, Inc.

DALLAS SEMICONDUCTOR is a registered trademark of Dallas Semiconductor Corporation.