Rev 0; 5/07

# 16MHz to 134MHz Spread-Spectrum Clock Modulator for LCD Panels



## General Description

The DS1083L is a spread-spectrum clock modulator IC that reduces EMI in high-clock, frequency-based, digital electronic equipment.

Using an integrated phase-locked loop (PLL), the DS1083L accepts an input clock signal in the range of 16MHz to 134MHz and delivers a spread-spectrum modulated output clock signal. The PLL modulates, or dithers, the output clock about the center input frequency at a pin-selectable magnitude. The DS1083L automatically adjusts the dither rate based on the input clock frequency to maximize the EMI reduction.

By dithering the system clock, all the address, data, and timing signals generated from this signal are also dithered so that the measured EMI at the fundamental and harmonic frequencies is greatly reduced. This is accomplished without changing clock rise/fall times or adding the space, weight, design time, and cost associated with mechanical shielding.

The DS1083L is provided in a low-cost, space-saving, 6-lead thin SOT23 package and operates over a full automotive temperature range of -40°C to +125°C.

## Applications

LCD Panels for TVs, Desktop Monitors, Notebook and Tablet PCs

Automotive Telematics and Infotainment

Printers

***Pin Configuration and Typical Operating Circuit appear at end of data sheet.***

## Features

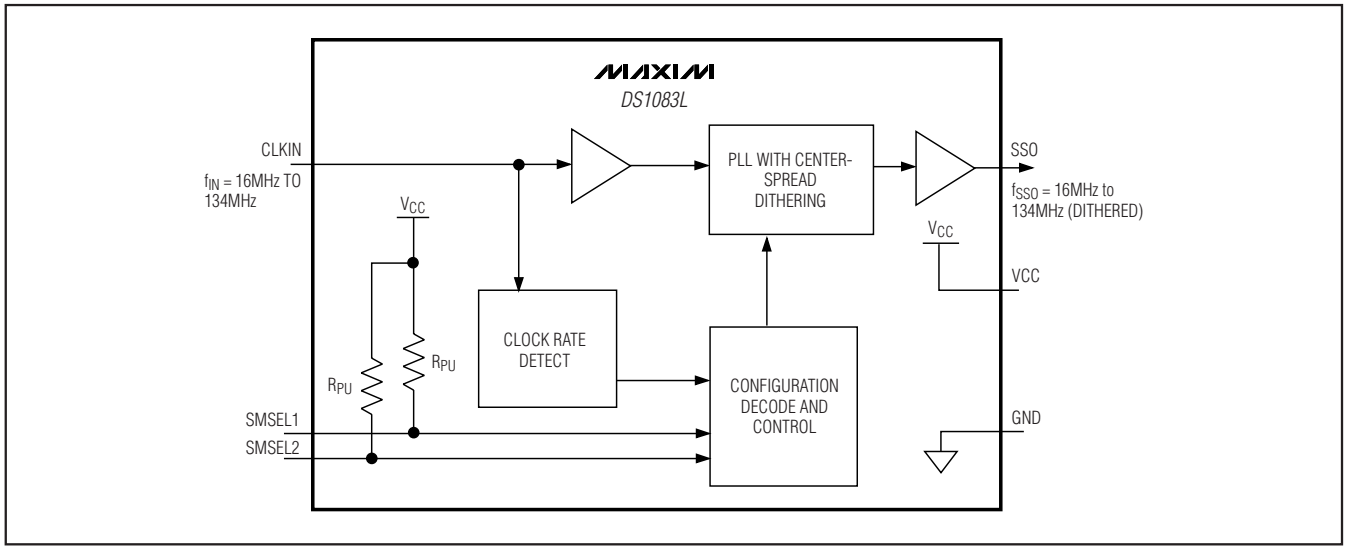
- **Modulates a 16MHz to 134MHz Clock with Center Spread-Spectrum Dithering**
- **Selectable Spread-Spectrum Modulation Magnitudes of:**
  - **±0.5%**
  - **±1%**
  - **±1.5%**
  - **±2%**
- **Low 75ps Cycle-to-Cycle Jitter**
- **Automatic Dither Cycle Rate Adjustment to Maximize EMI Reduction**
- **Low Cost**
- **Low Power Consumption**
- **3.3V Single Voltage Supply**
- **-40°C to +125°C Operating Temperature Range**
- **Small 6-Lead Thin SOT23 Package**

## Ordering Information

| PART | TEMP RANGE | PIN-PACKAGE |
|---|---|---|
| DS1083LR+T | -40°C to +125°C | 6 Thin SOT23 |

*+Denotes a lead-free package.*
*T = Tape and reel.*

## Block Diagram






***For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim's website at www.maxim-ic.com.***

# 16MHz to 134MHz Spread-Spectrum Clock Modulator for LCD Panels

## ABSOLUTE MAXIMUM RATINGS

Voltage Range on VCC Relative to GND.....-0.5V to +3.63V
Voltage Range on Any Lead Relative to GND.....-0.5V to ($V_{CC}$ + 0.5V), not to exceed +3.63V
Operating Temperature Range .....-40°C to +125°C
Storage Temperature Range .....-55°C to +125°C
Soldering Temperature.....Refer to the IPC/JEDEC J-STD-020 Specification.

*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°C to +125°C, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| $V_{CC}$ Supply Voltage | $V_{CC}$ | (Note 1) | 3.0 | | 3.6 | V |
| SMSEL1/SMSEL2 Input Logic 1 | $V_{IH}$ | | 0.7 x $V_{CC}$ | | $V_{CC}$ + 0.3 | V |
| SMSEL1/SMSEL2 Input Logic 0 | $V_{IL}$ | | -0.3 | | 0.3 x $V_{CC}$ | V |
| SSO Load | $C_L$ | $f_{SSO}$ < 80MHz | | | 15 | pF |
| | | 80MHz ≤ $f_{SSO}$ < 134MHz | | | 7 | |
| CLKIN Frequency | $f_{IN}$ | | 16 | | 134 | MHz |
| CLKIN Duty Cycle | $f_{INDC}$ | | 40 | | 60 | % |
| $V_{CC}$ Power-Up Time | $t_{PV}$ | GND to $V_{CCMIN}$ | | | 200 | ms |

## DC ELECTRICAL CHARACTERISTICS

($V_{CC}$ = +3.0V to +3.6V, $T_A$ = -40°C to +125°C, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Supply Current | $I_{CC}$ | $C_L$ = 7pF, $f_{IN}$ = 134MHz | | | 15 | mA |
| SMSEL1/SMSEL2 Pullup Resistance | $R_{PU}$ | $T_A$ = +25°C | 60 | 100 | 140 | kΩ |
| SMSEL1/SMSEL2 Input Leakage | $I_{IL}$ | 0V < $V_{IN}$ < $V_{CC}$ | | | ±80 | µA |
| Low-Level Output Voltage (SSO) | $V_{OL}$ | $I_{OL}$ = 4mA | | | 0.4 | V |
| High-Level Output Voltage (SSO) | $V_{OH}$ | $I_{OH}$ = -4mA | 2.4 | | | V |

## AC ELECTRICAL CHARACTERISTICS

($V_{CC}$ = +3.0V to +3.6V, $T_A$ = -40°C to +125°C, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| SSO Duty Cycle | $f_{SSODC}$ | Measured at $V_{CC}$/2 | 40 | | 60 | % |
| SSO Rise Time | $t_R$ | $C_L$ = 7pF | | 1 | | ns |
| SSO Fall Time | $t_F$ | $C_L$ = 7pF | | 1 | | ns |
| Peak Cycle-to-Cycle Jitter | $t_J$ | $T_A$ = -40°C to +85°C, 10,000 cycles | | 75 | | ps |

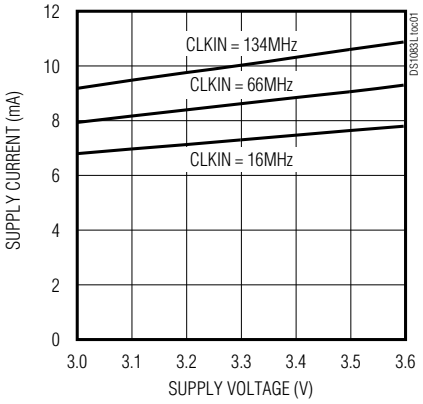
**Note 1:** All voltages referenced to ground. Currents into the IC are positive and currents out of the IC are negative.

# 16MHz to 134MHz Spread-Spectrum Clock Modulator for LCD Panels

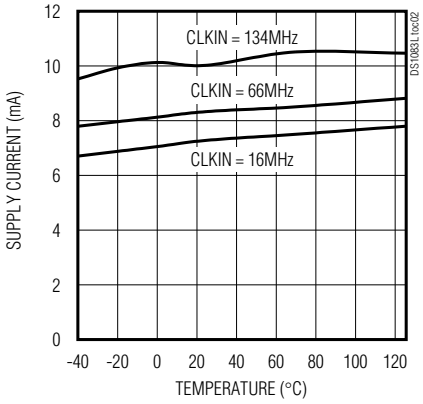
## Typical Operating Characteristics

($T_A$ = +25°C, unless otherwise noted.)

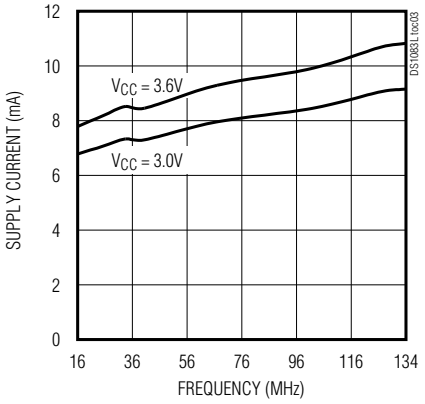
**SUPPLY CURRENT vs. SUPPLY VOLTAGE**



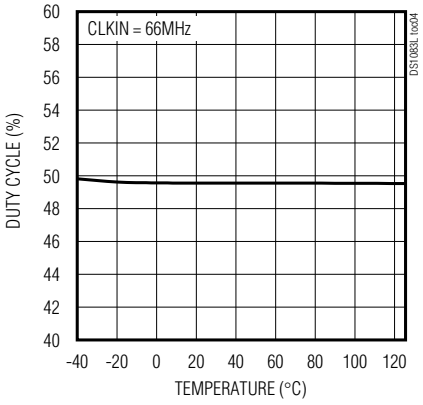

**SUPPLY CURRENT vs. TEMPERATURE**



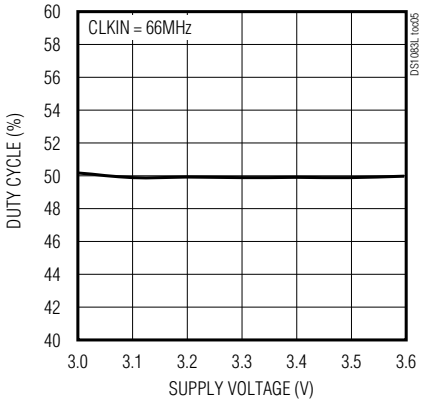

**SUPPLY CURRENT vs. FREQUENCY**



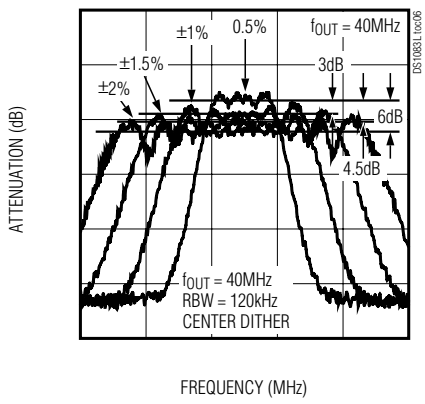

**DUTY CYCLE vs. TEMPERATURE**




**DUTY CYCLE vs. SUPPLY VOLTAGE**




**SPECTRUM ATTENUATION vs. FREQUENCY AT DIFFERENT DITHER AMPLITUDES**



# 16MHz to 134MHz Spread-Spectrum Clock Modulator for LCD Panels

## Pin Description

| PIN | NAME | DESCRIPTION | | |
|---|---|---|---|---|
| 1 | CLKIN | Clock Input. 16MHz to 134MHz clock input ($f_{IN}$). | | |
| 2 | GND | Ground | | |
| 3 | SSO | Spread-Spectrum Clock Output. Outputs a center-dithered spread-spectrum version of the clock input at CLKIN. | | |
| 4 | SMSEL2 | Spread-Spectrum Magnitude Select Inputs. These digital inputs select the desired spread-spectrum magnitude as shown in the table below. Both inputs contain pullup resistors ($R_{PU}$) to $V_{CC}$. | | |
| | | **SMSEL2** | **SMSEL1** | **MAGNITUDE SELECTED (%)** |
| 5 | SMSEL1 | 0 | 0 | ±2 |
| | | 0 | 1 | ±1.5 |
| | | 1 | 0 | ±1 |
| | | 1 | 1 | ±0.5 |
| 6 | VCC | Supply Voltage | | |

## Detailed Description

The DS1083L modulates an input clock to provide a center-dithered spread-spectrum output. A 16MHz to 134MHz clock is applied to the CLKIN pin. The PLL dithers the output clock about its center frequency at a user-selectable magnitude. The user is required to cycle power to the device each time there is a change in the input frequency, for the PLL to lock correctly. This ensures proper output frequency and dither rate. The desired spread-spectrum magnitude is selected using input pins SMSEL1 and SMSEL2 (see the *Pin Description* for details). The DS1083L is capable of generating spread-spectrum clocks from 16MHz to 134MHz.

### Dither-Rate Selection

The output spread-spectrum dither rate is automatically adjusted depending on the input frequency, to maximize EMI reduction.

The dither cycle rate is:

$f_{IN}/512$, if $f_{IN}$ is between 16MHz and 33MHz

$f_{IN}/1024$, if $f_{IN}$ is between 33MHz and 64MHz

$f_{IN}/2048$, if $f_{IN}$ is between 64MHz and 134MHz

On power-up, the output clock (SSO) remains three-stated until it reaches a stable frequency ($f_{SSO}$). The dither rate is selected by sampling the input clock at power-up.

## Applications Information

### Power-Supply Decoupling

To achieve best results, it is highly recommended that a decoupling capacitor is used on the IC power-supply pins. Typical values of decoupling capacitors are 0.01µF and 0.1µF. 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.

## Chip Information

SUBSTRATE CONNECTED TO GROUND

# 16MHz to 134MHz Spread-Spectrum Clock Modulator for LCD Panels

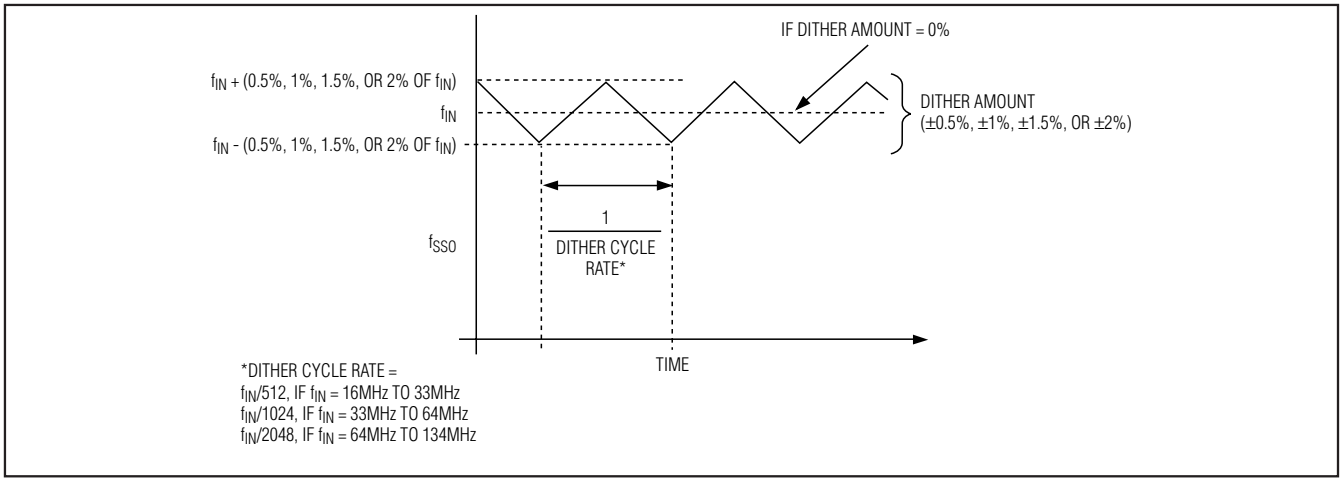
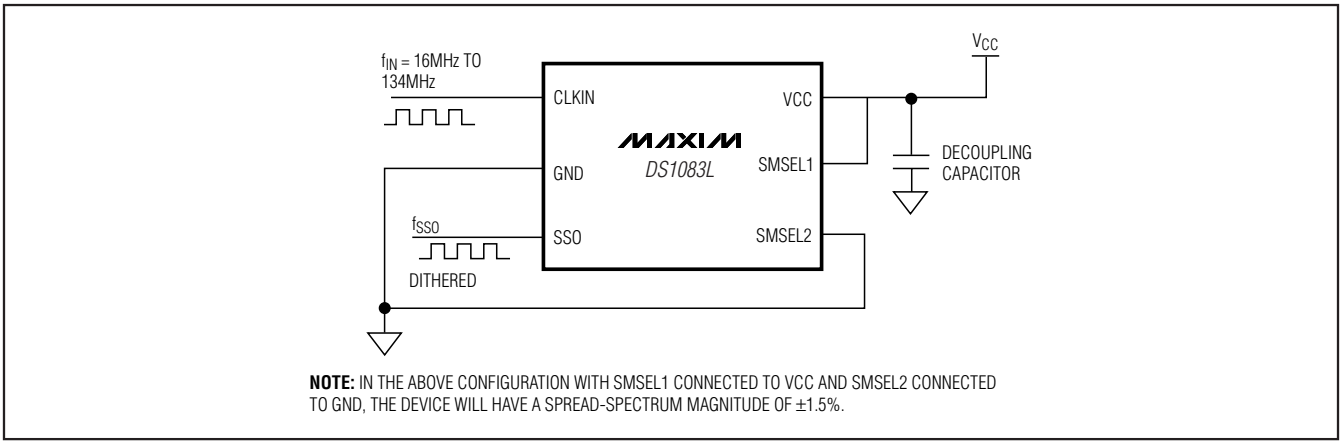


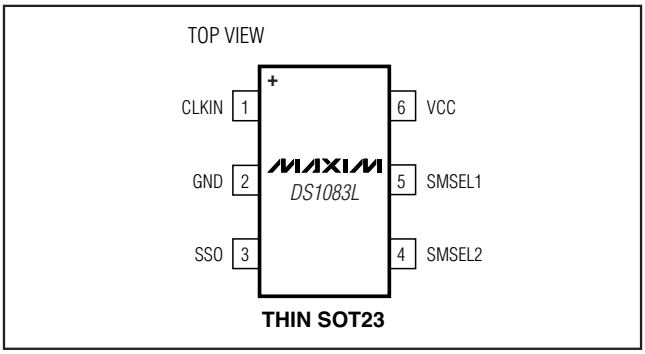

*Figure 1. Spread-Spectrum Frequency Modulation*

## Typical Operating Circuit




**NOTE:** IN THE ABOVE CONFIGURATION WITH SMSEL1 CONNECTED TO VCC AND SMSEL2 CONNECTED TO GND, THE DEVICE WILL HAVE A SPREAD-SPECTRUM MAGNITUDE OF ±1.5%.

## Pin Configuration




**THIN SOT23**

## Package Information

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

| PACKAGE TYPE | DOCUMENT NO. |
|---|---|
| 6 Thin SOT23 | 21-0114 |

*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.*



© 2007 Maxim Integrated Products MAXIM is a registered trademark of Maxim Integrated Products, Inc.