1kHz to 30MHz Resistor Set SOT-23 Oscillator

January 2001

FEATURES

- **One External Resistor Sets the Frequency**
- **1kHz to 30MHz Frequency Range**
- **SOT-23 Miniature Package**
- Frequency Error ≤1.5% 5kHz to 20MHz (T_A = 25°C)
- Frequency Error ≤2% 5kHz to 20MHz (T_A = 0°C to 70°C)
- ±40ppm/°C Temperature Stability
- 0.05%/V Supply Stability
- 50% ±1% Duty Cycle 1kHz to 2MHz
- 50% ±5% Duty Cycle 2MHz to 20MHz
- 1mA Typical Supply Current
- 100Ω CMOS Output Driver
- Operates from a Single 2.7V to 5.5V Supply

APPLICATIONS

- Low Cost Precision Oscillator
- Charge Pump Driver
- Switching Power Supply Clock Reference
- Clocking Switched Capacitor Filters
- Fixed Crystal Oscillator Replacement
- Ceramic Oscillator Replacement
- Small Footprint Replacement for Econ Oscillators

DESCRIPTION

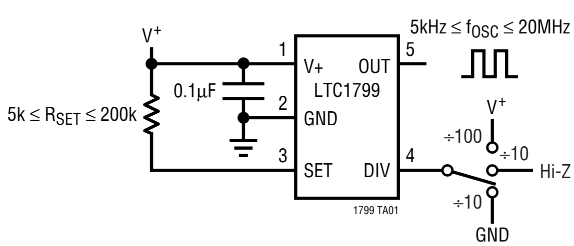
The LTC®1799 is a precision oscillator that is easy to use and occupies very little PC board space. The oscillator frequency is programmed by a single external resistor (R_{SET}). The LTC1799 has been designed for high accuracy operation (≤1.5% frequency error) without the need for external trim components.

The LTC1799 operates with a single 2.7V to 5.5V power supply and provides a rail-to-rail, 50% duty cycle square wave output. The CMOS output driver ensures fast rise/fall times and rail-to-rail switching. The frequency-setting resistor can vary from 3.32k to 1M to select a master oscillator frequency between 100kHz and 30MHz (5V supply). The three-state DIV input determines whether the master clock is divided by 1, 10 or 100 before driving the output, providing three frequency ranges spanning 1kHz to 30MHz (5V supply). The LTC1799 features a proprietary feedback loop that linearizes the relationship between R_{SET} and frequency, eliminating the need for tables to calculate frequency. The oscillator can be easily programmed using the simple formula outlined below:

$$f_{OSC} = 10MHz \bullet \left(\frac{10k}{N \bullet R_{SET}}\right), \quad N = \begin{cases} 100, & \text{DIV PIN} = V^+ \\ 10, & \text{DIV PIN} = \text{Hi-Z} \\ 1, & \text{DIV PIN} = \text{GND} \end{cases}$$

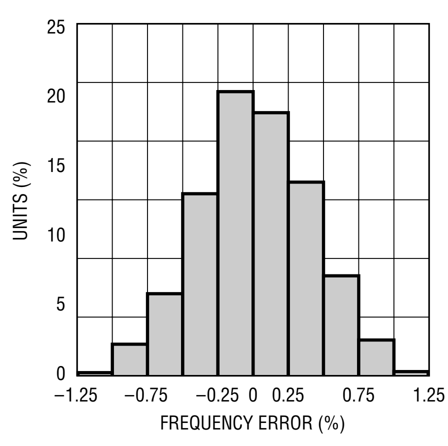
TYPICAL APPLICATION

Basic Connection



SOT-23 Actual Size

Typical Distribution of Frequency Error, T_A = 25°C



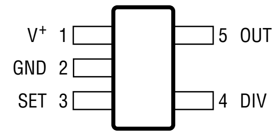
ABSOLUTE MAXIMUM RATINGS

(Note 1)

Supply Voltage (V^+) to GND .... –0.3V to 6V
DIV to GND .... –0.3V to (V^+ + 0.3V)
SET to GND .... –0.3V to (V^+ + 0.3V)
OUT to GND .... –0.3V to (V^+ + 0.3V)
Operating Temperature Range
  LTC1799C .... 0°C to 70°C
  LTC1799I .... –40°C to 85°C
Storage Temperature Range .... –65°C to 150°C
Lead Temperature (Soldering, 10 sec) .... 300°C

PACKAGE/ORDER INFORMATION

TOP VIEW



S5 PACKAGE
5-LEAD PLASTIC SOT-23

T_{JMAX} = 125°C, θ_{JA} = 256°C/W

ORDER PART NUMBER	S5 PART MARKING
LTC1799CS5	LTND
LTC1799IS5	LTNE

Consult factory for parts specified with wider operating temperature ranges.

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 25°C. V^+ = 2.7V to 5.5V, R_L=5k, C_L = 5pF, Pin 4 = V^+ unless otherwise noted. All voltages are with respect to GND.

SYMBOL	PARAMETER	CONDITIONS			MIN	TYP	MAX	UNITS
Δf	Frequency Accuracy	V^+ = 5V	5kHz < f < 20MHz			±0.5	±1.5	%
			5kHz < f < 20MHz, LTC1799C	●			±2	%
			5kHz < f < 20MHz, LTC1799I	●			±2.5	%
	(Notes 2, 3)		1kHz < f < 5kHz			±2.5		%
			20MHz < f < 30MHz			±2.5		%
		V^+ = 3V	5kHz < f < 10MHz			±0.5	±1.5	%
			5kHz < f < 10MHz, LTC1799C	●			±2	%
			5kHz < f < 10MHz, LTC1799I	●			±2.5	%
			1kHz < f < 5kHz			±2.5		%
			10MHz < f < 20MHz			±2.5		%
R_{SET}	Frequency-Setting Resistor Range	|Δf| < 1.5%	V^+ = 5V		5		200	kΩ
			V^+ = 3V		10		200	kΩ
f_{MAX}	Maximum Frequency	|Δf| < 2.5%, Pin 4= 0V	V^+ = 5V			30		MHz
			V^+ = 3V			20		MHz
f_{MIN}	Minimum Frequency	|Δf| < 2.5%, Pin 4= V^+				1		kHz
Δf/ΔT	Freq Drift Over Temp (Note 3)	R_{SET} = 31.6k		●		±0.004		%/°C
Δf/ΔV	Freq Drift Over Supply (Note 3)	V^+ = 2.7V to 5.5V, R_{SET} = 31.6k		●		0.05	0.1	%/V
	Timing Jitter (Note 4)	Pin 4 = V^+				0.06		%
		Pin 4 = Floating				0.13		%
		Pin 4 = 0V				0.4		%
	Long-Term Stability of Output Frequency					300		ppm/√kHr
	Duty Cycle	Pin 4 = V^+ or Floating (DIV Either by 100 or 10)		●	49	50	51	%
		Pin 4 = 0V (DIV by 1)		●	45	50	55	%
V^+	Operating Supply Range			●	2.7		5.5	V
I_S	Power Supply Current	R_{SET} = 200k, Pin 4 = V^+, R_L = 0	V^+ = 5V	●		0.7	1.1	mA
		R_{SET} = 10k, Pin 4 = 0V, No Load	V^+ = 5V	●			2.4	mA
			V^+ = 3V	●			2	mA
V_{IH}	High Level DIV Input Voltage			●	V^+ – 0.4			V
V_{IL}	Low Level DIV Input Voltage			●			0.5	V
I_{DIV}	DIV Input Current	Pin 4 = V^+		●		5	8	µA
		Pin 4 = 0V		●		–5	8	µA

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 25°C. V^+ = 2.7V to 5.5V, R_L=5k, C_L = 5pF, Pin 4 = V^+ unless otherwise noted. All voltages are with respect to GND.

SYMBOL	PARAMETER	CONDITIONS			MIN	TYP	MAX	UNITS
V_{OH}	High Level Output Voltage	V^+ = 5V	I_{OH} = –1mA	●	4.8	4.95		V
			I_{OH} = –4mA	●	4.5	4.8		V
		V^+ = 3V	I_{OH} = –1mA	●	2.7	2.9		V
			I_{OH} = –4mA	●	2.2	2.6		V
V_{OL}	Low Level Output Voltage	V^+ = 5V	I_{OL} = 1mA	●		0.05	0.15	V
			I_{OL} = 4mA	●		0.2	0.4	V
		V^+ = 3V	I_{OL} = 1mA	●		0.1	0.3	V
			I_{OL} = 4mA	●		0.4	0.7	V
t_r	OUT Rise Time (Note 5)	V^+ = 5V	Pin 4 = V^+ or Floating, R_L = 0			14		ns
			Pin 4 = 0V, R_L = 0			7		ns
		V^+ = 3V	Pin 4 = V^+ or Floating, R_L = 0			19		ns
			Pin 4 = 0V, R_L = 0			11		ns
t_f	OUT Fall Time (Note 5)	V^+ = 5V	Pin 4 = V^+ or Floating, R_L = 0			13		ns
			Pin 4 = 0V, R_L = 0			6		ns
		V^+ = 3V	Pin 4 = V^+ or Floating, R_L = 0			19		ns
			Pin 4 = 0V, R_L = 0			10		ns

Note 1: Absolute Maximum Ratings are those values beyond which the life of the device may be impaired.

Note 2: Frequencies near 100kHz and 1MHz may be generated using two different values of R_{SET} (see the Table 1 in the Applications Information section). For these frequencies, the error is specified under the following assumption: 10k < R_{SET} ≤ 100k.

Note 3: Frequency error (defined as the deviation from the f_{OSC} equation) includes drift over temperature and over supply.

Note 4: Jitter is the ratio of the peak-to-peak distribution of the period to the mean of the period. This specification is based on characterization and is not 100% tested.

Note 5: Output rise and fall times are measured between the 10% and 90% power supply levels. These specifications are based on characterization.

PIN FUNCTIONS

V^+ (Pin 1): Voltage Supply (2.7V ≤ V^+ ≤ 5.5V). This supply must be kept free from noise and ripple. It should be bypassed directly to a ground plane.

GND (Pin 2): Ground. Should be tied to a ground plane for best performance.

SET (Pin 3): Frequency-Setting Resistor Input. The value of the resistor connected between this pin and V^+ determines the oscillator frequency. The voltage on this pin is held by the LTC1799 to approximately 1.1V below the V^+ voltage. For best performance, use a precision metal film resistor with a value between 10k and 200k and limit the capacitance on this pin to less than 2pF.

DIV (Pin 4): Divider-Setting Input. This three-state input selects among three divider settings, determining the value of N in the frequency equation. Pin 4 should be tied to GND for the ÷1 setting, the highest frequency range. Floating Pin 4 divides the master oscillator by 10. Pin 4 should be tied to V^+ for the ÷100 setting, the lowest frequency range. To detect a floating DIV pin, the LTC1799 attempts to pull the pin toward midsupply. Therefore, driving the DIV pin high requires sourcing approximately 5μA. Likewise, driving DIV low requires sinking 5μA. When floated, the DIV pin will be held near midsupply by these current sources. When it is floated, it is recommended that the DIV pin be bypassed by a 1nF capacitor or surrounded by a ground shield to prevent excessive coupling from other PCB traces.

OUT (Pin 5): Oscillator Output. This pin can easily drive 5kΩ or 10pF loads. Larger loads may cause inaccuracies due to supply bounce at high frequencies.

APPLICATIONS INFORMATION

Selecting the Divider Setting and Resistor

The LTC1799's master oscillator has a frequency range spanning 0.1MHz to 30MHz. However, accuracy may suffer if the master oscillator is operated at greater than 10MHz with a supply voltage lower than 4V. A programmable divider extends the frequency range to greater than three decades. Table 1 describes the recommended frequencies for each divider setting. Note that the ranges overlap; at some frequencies there are two divider/resistor combinations that result in the desired frequency.

In general, any given oscillator frequency (f_{OSC}) should be obtained using the lowest master oscillator frequency. Lower master oscillator frequencies use less power and are more accuate. For instance, f_{OSC} = 100kHz can be obtained by either R_{SET} = 10k, N = 100, master oscillator = 10MHz or R_{SET} = 100k, N = 10, master oscillator = 1MHz. The R_{SET} = 100k is preferred for lower power and better accuracy.

Table 1. Frequency Range vs Divider Setting

DIVIDER SETTING			FREQUENCY RANGE
÷1	⇒	DIV (Pin 4) = GND	>500kHz*
÷10	⇒	DIV (Pin 4) = Floating	50kHz to 1MHz
÷100	⇒	DIV (Pin 4) = V^+	< 100kHz

*At master oscillator frequencies greater than 10MHz (R_{SET} < 10kΩ), the LTC1799 may suffer reduced accuracy with a supply voltage less than 4V.

After choosing the proper divider setting, determine the correct frequency-setting resistor. Because of the linear correspondence between oscillation period and resistance, a simple equation relates resistance with frequency.

$$R_{SET} = 10k \bullet [10MHz/(N \bullet f_{OSC})],\ N = 1, 10, 100$$
$$(R_{SETMIN} = 3.32k\ (5V\ Supply),\ 5k\ (3V\ Supply),\ R_{SETMAX} = 1M)$$

Any resistor, R_{SET}, tolerance adds to the inaccuracy of the oscillator, f_{OSC}.

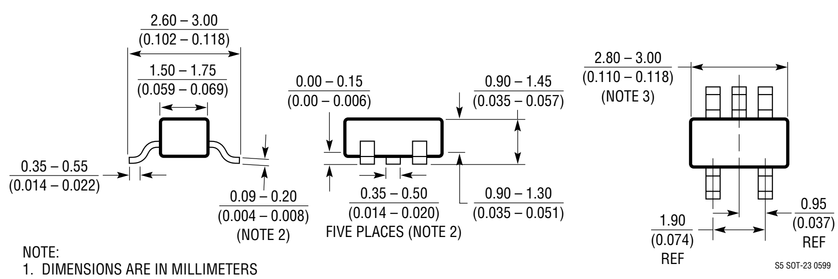
Settling Time

The settling time is proportional to R_{SET} and is approximately $t_{SETTLE} \approx R_{SET} \bullet (5\mu s/k\Omega)$. This parameter is guaranteed by design and not 100% tested.

PACKAGE DESCRIPTION

Dimensions in inches (millimeters) unless otherwise noted.

S5 Package
5-Lead Plastic SOT-23
(LTC DWG # 05-08-1633)



NOTE:
1. DIMENSIONS ARE IN MILLIMETERS
2. DIMENSIONS ARE INCLUSIVE OF PLATING
3. DIMENSIONS ARE EXCLUSIVE OF MOLD FLASH AND METAL BURR
4. MOLD FLASH SHALL NOT EXCEED 0.254mm
5. PACKAGE EIAJ REFERENCE IS SC-74A (EIAJ)

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1799i LT/TP 0101 2K • PRINTED IN USA
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