

CDCEL824 可编程 2 PLL 时钟合成器

1 特性

- 灵活的时钟驱动器
 - 3 个用户定义的控制输入 [S0/S1/S2]：例如，开关频率、输出使能或断电
 - 启用 0-PPM 时钟生成
- 系统内可编程性和 EEPROM
 - 串行可编程易失性寄存器
 - 非易失性 EEPROM 以存储客户设置
- 灵活的输入计时理念
 - 外部晶振：20MHz 至 30MHz
 - 单端低电压互补金属氧化物半导体 (LVCMOS) 高达 130MHz
- 高达 201MHz 的可选输出频率
- 低噪声 PLL 内核
 - 集成了 PLL 环路滤波器组件
 - 低周期抖动（典型值为 80ps）
- 1.8V 器件电源
- 温度范围：–40°C 至 85°C
- 采用薄型小外形尺寸 (TSSOP) 封装

2 应用

激光测距应用

3 说明

CDCEL824 是一款基于锁相环 (PLL) 的模块化、低成本、高性能可编程时钟合成器/乘法器/除法器。该器件最多可从单输入频率中生成四个输出时钟。在系统内最多可使用两个独立可配置 PLL 在任何时钟频率下（最高可达 201MHz）对各输出进行编程。

CDCEL824 具备一个独立的输出电源引脚 V_{DDOUT}，其电压为 1.8V。

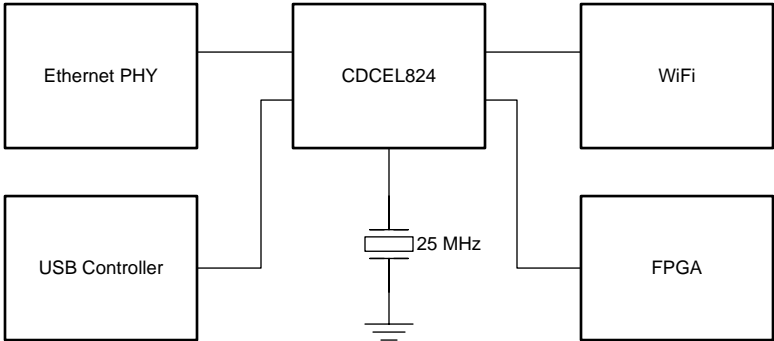
此输入接受一个外部晶振或 LVCMOS 时钟信号。对于晶振输入，片上负载电容足以满足大多数应用的要求。负载电容值可在 0pF 至 20pF 的范围内设定。

器件信息⁽¹⁾

| 部件号 | 封装 | 封装尺寸（标称值） |
|----------|------------|-----------------|
| CDCEL824 | TSSOP (16) | 5.00mm x 4.40mm |

(1) 要了解所有可用封装，请见数据表末尾的可订购产品附录。

典型电路原理图



目录

| | | | | | |
|----------|--|----------|-----------|---|-----------|
| 1 | 特性 | 1 | 9.2 | Functional Block Diagram | 9 |
| 2 | 应用 | 1 | 9.3 | Feature Description | 10 |
| 3 | 说明 | 1 | 9.4 | Device Functional Modes | 12 |
| 4 | 修订历史记录 | 2 | 9.5 | Programming | 13 |
| 5 | 说明 (续) | 2 | 9.6 | Register Maps | 15 |
| 6 | Pin Configuration and Functions | 3 | 10 | Application and Implementation | 22 |
| 7 | Specifications | 4 | 10.1 | Application Information | 22 |
| 7.1 | Absolute Maximum Ratings | 4 | 10.2 | Typical Application | 22 |
| 7.2 | ESD Ratings | 4 | 11 | Power Supply Recommendations | 24 |
| 7.3 | Recommended Operating Conditions | 4 | 12 | Layout | 24 |
| 7.4 | Thermal Information | 5 | 12.1 | Layout Guidelines | 24 |
| 7.5 | Electrical Characteristics | 6 | 12.2 | Layout Example | 25 |
| 7.6 | CLK_IN Timing Requirements | 7 | 13 | 器件和文档支持 | 26 |
| 7.7 | SDA/SCL Timing Requirements | 7 | 13.1 | 文档支持 | 26 |
| 7.8 | EEPROM Specification | 7 | 13.2 | 社区资源 | 26 |
| 7.9 | Typical Characteristics | 7 | 13.3 | 商标 | 26 |
| 8 | Parameter Measurement Information | 8 | 13.4 | 静电放电警告 | 26 |
| 9 | Detailed Description | 9 | 13.5 | Glossary | 26 |
| 9.1 | Overview | 9 | 14 | 机械、封装和可订购信息 | 26 |

4 修订历史记录

注：之前版本的页码可能与当前版本有所不同。

| Changes from Original (June 2015) to Revision A | Page |
|---|----------|
| • 已更改“产品定制”至“产品目录数据表” | 1 |
| • Changed order of pin function rows to be by number per format rules | 3 |
| • Changed <i>Thermal Information</i> table format; move <i>EEPROM Spec</i> table per format rules | 5 |

5 说明 (续)

例如，深 M/N 分频比可从 27MHz 基准输入频率中生成零 ppm 音频/视频、网络互联（无线局域网 (WLAN)、Bluetooth、以太网、全球定位系统 (GPS)）或接口（通用串行总线 (USB)、IEEE1394、记忆棒）时钟。

该器件会根据 PLL 频率和分频器设置自动调整内部环路滤波器组件，从而使各 PLL 具备较高稳定性和优化的抖动传输特性。

为了轻松实现器件自定义来满足应用需要，该器件支持使用非易失性 EEPROM 进行编程。该器件预设为采用默认出厂配置，允许在安装于印刷电路板 (PCB) 前按照另一种应用配置重新编程，或者通过系统内部编程进行重新编程。所有器件设置均可通过串行数据/串行时钟 (SDA/SCL) 总线（一种二线制串行接口）进行编程。

三个可自由编程的控制输入（S0、S1 和 S2）可用于选择不同频率或其他控制功能，包括将输出禁用为低电平、在高阻抗状态下输出、断电以及 PLL 旁路等。

CDCx824 可在 1.8V 电压的作用下运行，其运行温度范围为 -40°C 至 85°C。

6 Pin Configuration and Functions

**PW Package
20-Pin TSSOP
Top View**

| | | | |
|---------|---|----|--------|
| Xin/Clk | 1 | 16 | Xout |
| S0 | 2 | 15 | S1/SDA |
| Vdd | 3 | 14 | S2/SCL |
| Vctr | 4 | 13 | DNC |
| GND | 5 | 12 | GND |
| Vddout | 6 | 11 | Y1 |
| Y3 | 7 | 10 | Y2 |
| Y4 | 8 | 9 | Vddout |

Pin Functions

| PIN | | I/O | DESCRIPTION |
|--------|--------------------|----------|--|
| NUMBER | NAME | | |
| 1 | Xin/CLK | I | Crystal oscillator input or LVCMOS clock Input (selectable via SDA/SCL bus). |
| 2 | S0 | I | User-programmable control input S0; LVCMOS inputs; internal pullup. |
| 3 | V _{DD} | Power | 1.8-V power supply for the device |
| 4 | V _{Ctrl} | I | VCXO control voltage (leave open or pull up when not used). |
| 5, 12 | GND | Ground | Ground |
| 6, 9 | V _{DDOUT} | Power | 1.8-V supply for all outputs |
| 7 | Y3 | O | LVCMOS outputs |
| 8 | Y4 | O | LVCMOS outputs |
| 10 | Y2 | O | LVCMOS outputs |
| 11 | Y1 | O | LVCMOS outputs |
| 13 | DNC | O | Reserved pin, do not connect |
| 14 | SCL/S2 | I | SCL: Serial clock input (default configuration), LVCMOS; internal pullup. S2: User-programmable control input; LVCMOS inputs; internal pullup. |
| 15 | SDA/S1 | I/O or I | SDA: Bidirectional serial data input/output (default configuration), LVCMOS; internal pullup S1: User-programmable control input; LVCMOS inputs; internal pullup. |
| 16 | Xout | O | Crystal oscillator output (leave open or pull up when not used). |

7 Specifications

7.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)⁽¹⁾

| | | MIN | MAX | UNIT |
|------------------|---|------|-----------------------|------|
| V _{DD} | Supply voltage range | −0.5 | 2.5 | V |
| V _I | Input voltage range ⁽²⁾ ⁽³⁾ | −0.5 | V _{DD} + 0.5 | V |
| V _O | Output voltage range ⁽²⁾ | −0.5 | V _{DD} + 0.5 | V |
| I _I | Input current (V _I < 0, V _I > V _{DD}) | | 20 | mA |
| I _O | Continuous output current | | 50 | mA |
| T _J | Maximum junction temperature | | 125 | °C |
| T _{stg} | Storage temperature range | −65 | 150 | °C |

- (1) 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 under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) The input and output negative voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
- (3) SDA and SCL can go up to 3.6V as stated in the *Recommended Operating Conditions* table.

7.2 ESD Ratings

| | | VALUE | UNIT |
|--------------------|-------------------------|--|-------|
| V _(ESD) | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins ⁽¹⁾ | ±2000 |
| | | Charged device model (CDM), per JEDEC specification JESD22-C101, all pins ⁽²⁾ | ±1500 |

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

7.3 Recommended Operating Conditions

| | | MIN | NOM | MAX | UNIT |
|--|--|---------------------|---------------------|---------------------|------|
| V _{DD} | Device supply voltage | 1.7 | 1.8 | 1.9 | V |
| V _{DDOUT} | Output Yx supply voltage for CDCEL824 | 1.7 | | 1.9 | V |
| V _{IL} | Low-level input voltage LVCMOS | | | 0.3 V _{DD} | V |
| V _{IH} | High-level input voltage LVCMOS | 0.7 V _{DD} | | | V |
| V _{I(thresh)} | Input voltage threshold LVCMOS | | 0.5 V _{DD} | | V |
| V _{I(S)} | Input voltage range S0 | 0 | | 1.9 | V |
| | Input voltage range S1, S2, SDA, SCL; V _{I(thresh)} = 0.5 V _{DD} | 0 | | 3.6 | |
| V _{I(CLK)} | Input voltage range CLK | 0 | | 1.9 | V |
| I _{OH} / I _{OL} | Output current (V _{DDOUT} = 1.8 V) | | | ±8 | mA |
| C _L | Output load LVCMOS | | | 15 | pF |
| T _A | Operating free-air temperature | −40 | | 85 | °C |
| RECOMMENDED CRYSTAL/VCXO SPECIFICATIONS⁽¹⁾ | | | | | |
| f _{Xtal} | Crystal input frequency range (fundamental mode) | 10 | | 30 | MHz |
| ESR | Effective series resistance | | | 100 | Ω |
| f _{PR} | Pulling range (0 V ≤ V _{Ctrl} ≤ 1.8 V) ⁽²⁾ | ±120 | ±150 | | ppm |
| V _{Ctrl} | Frequency control voltage | 0 | | V _{DD} | V |
| C ₀ /C ₁ | Pullability ratio | | | 220 | |
| C _L | On-chip load capacitance at Xin and Xout | 0 | | 20 | pF |

- (1) For more information about VCXO configuration, and crystal recommendation, see application report (SCAA085).
- (2) Pulling range depends on crystal-type, on-chip crystal load capacitance and PCB stray capacitance; pulling range of min ±120 ppm applies for crystal listed in the application report (SCAA085).

7.4 Thermal Information

| THERMAL METRIC ⁽¹⁾⁽²⁾ | | AIRFLOW (lfm) | CDCEL824 | UNIT |
|----------------------------------|--|------------------|------------|------|
| | | | PW (TSSOP) | |
| | | | 30 PINS | |
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance | 0 | 101 | °C/W |
| | | 150 | 85 | °C/W |
| | | 200 | 84 | °C/W |
| | | 250 | 82 | °C/W |
| | | 500 | 74 | °C/W |
| $R_{\theta JC(top)}$ | Junction-to-case (top) thermal resistance | | 42 | °C/W |
| $R_{\theta JB}$ | Junction-to-board thermal resistance | | 58 | °C/W |
| Ψ_{JB} | Junction-to-board characterization parameter | | 64 | °C/W |
| $R_{\theta JC(bot)}$ | Junction-to-case (bottom) thermal resistance | | 1.0 | °C/W |

- (1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report, [SPRA953](#).
- (2) The package thermal impedance is calculated in accordance with JESD 51 and JEDEC2S2P (high-k board).

7.5 Electrical Characteristics

over recommended operating free-air temperature range (unless otherwise noted)

| | | TEST CONDITIONS | | MIN | TYP ⁽¹⁾ | MAX | UNIT |
|---|---|---|----------------------------|---------------------|---------------------|-----|------|
| OVERALL PARAMETER | | | | | | | |
| I _{DD} | Supply current (see Figure 1) | All outputs off, f _{CLK} = 27 MHz, f _{VCO} = 135 MHz; f _{OUT} = 27 MHz | All PLLS on | 20 | | mA | |
| | | | Per PLL | 9 | | | |
| I _{DDOUT} | Supply current (see Figure 2) | No load, all outputs on, f _{OUT} = 27 MHz | V _{DDOUT} = 1.8 V | 1 | | mA | |
| I _{DDPD} | Power-down current. Every circuit powered down except SDA/SCL | f _{IN} = 0 MHz, | V _{DD} = 1.9 V | 30 | | μA | |
| V _{PUC} | Supply voltage V _{DD} threshold for power-up control circuit | | | 0.85 | 1.45 | V | |
| f _{VCO} | VCO frequency range of PLL | | | 80 | 201 | MHz | |
| f _{OUT} | LVMOS output frequency | V _{DDOUT} = 1.8 V | | 201 | | MHz | |
| LVMOS PARAMETER | | | | | | | |
| V _{IK} | LVMOS input voltage | V _{DD} = 1.7 V; I _S = −18 mA | | | −1.2 | V | |
| I _I | LVMOS input current | V _I = 0 V or V _{DD} ; V _{DD} = 1.9 V | | | ±5 | μA | |
| I _{IH} | LVMOS input current for S0/S1/S2 | V _I = V _{DD} ; V _{DD} = 1.9 V | | | 5 | μA | |
| I _{IL} | LVMOS Input current for S0/S1/S2 | V _I = 0 V; V _{DD} = 1.9 V | | | −4 | μA | |
| C _I | Input capacitance at Xin/CIk | V _{CIk} = 0 V or V _{DD} | | 6 | | pF | |
| | Input capacitance at Xout | V _{Ixout} = 0 V or V _{DD} | | 2 | | | |
| | Input capacitance at S0/S1/S2 | V _{IS} = 0 V or V _{DD} | | 3 | | | |
| LVMOS PARAMETER for V _{DDOUT} = 1.8 V – MODE | | | | | | | |
| V _{OH} | LVMOS high-level output voltage | V _{DDOUT} = 1.7 V, I _{OH} = −0.1 mA | | 1.6 | | V | |
| | | V _{DDOUT} = 1.7 V, I _{OH} = −4 mA | | 1.4 | | | |
| | | V _{DDOUT} = 1.7 V, I _{OH} = −8 mA | | 1.1 | | | |
| V _{OL} | LVMOS low-level output voltage | V _{DDOUT} = 1.7 V, I _{OL} = 0.1 mA | | | 0.1 | V | |
| | | V _{DDOUT} = 1.7 V, I _{OL} = 4 mA | | | 0.3 | | |
| | | V _{DDOUT} = 1.7 V, I _{OL} = 8 mA | | | 0.6 | | |
| t _{PLH} , t _{PHL} | Propagation delay | All PLL bypass | | 2.6 | | ns | |
| t _r /t _f | Rise and fall time | V _{DDOUT} = 1.8 V (20%–80%) | | 0.7 | | ns | |
| t _{jitter(cc)} | Cycle-to-cycle jitter ⁽²⁾ ⁽³⁾ | 1 PLL switching, Y1-to-Y2 | | 80 | 110 | ps | |
| | | 2 PLL switching, Y1-to-Y4 | | 130 | 200 | | |
| t _{jitter(per)} | Peak-to-peak period jitter ⁽³⁾ | 1 PLL switching, Y1-to-Y2 | | 100 | 130 | ps | |
| | | 2 PLL switching, Y1-to-Y4 | | 150 | 220 | | |
| t _{sk(o)} | Output skew ⁽⁴⁾ | f _{OUT} = 50 MHz; Y1-to-Y2 | | | 50 | ps | |
| | | f _{OUT} = 50 MHz; Y1-to-Y4 | | | 110 | | |
| odc | Output duty cycle ⁽⁵⁾ | f _{VCO} = 100 MHz; Pdiv = 1 | | 45% | 55% | | |
| SDA/SCL PARAMETER | | | | | | | |
| V _{IK} | SCL and SDA input clamp voltage | V _{DD} = 1.7 V; I _I = −18 mA | | | −1.2 | V | |
| I _{IH} | SCL and SDA input current | V _I = V _{DD} ; V _{DD} = 1.9 V | | | ±10 | μA | |
| V _{IH} | SDA/SCL input high voltage ⁽⁶⁾ | | | 0.7 V _{DD} | | V | |
| V _{IL} | SDA/SCL input low voltage ⁽⁶⁾ | | | | 0.3 V _{DD} | V | |
| V _{OL} | SDA low-level output voltage | I _{OL} = 3 mA V _{DD} = 1.7 V | | | 0.2 V _{DD} | V | |
| C _I | SCL/SDA Input capacitance | V _I = 0 V or V _{DD} | | 3 | 10 | pF | |

(1) All typical values are at respective nominal V_{DD}.

(2) 10,000 cycles

(3) Jitter depends on configuration. Jitter data is for input frequency = 27 MHz, f_{VCO} = 135 MHz, f_{OUT} = 27 MHz. f_{OUT} = 3.072 MHz or input frequency = 27 MHz, f_{VCO} = 108 MHz, f_{OUT} = 27 MHz. f_{OUT} = 16.384 MHz, f_{OUT} = 25 MHz, f_{OUT} = 74.25 MHz, f_{OUT} = 48 MHz

(4) The t_{sk(o)} specification is only valid for equal loading of each bank of outputs, and the outputs are generated from the same divider, data sampled on rising edge (t_r).

(5) odc depends on output rise- and fall time (t_r/t_f).

(6) SDA and SCL pins are 3.3-V tolerant.

7.6 CLK_IN Timing Requirements

over recommended ranges of supply voltage, load, and operating free-air temperature

| | | MIN | NOM | MAX | UNIT |
|--------------|--|-----------------|-----|-----|------|
| f_{CLK} | LVC MOS clock input frequency | PLL bypass mode | | 0 | MHz |
| | | PLL mode | | 8 | |
| t_r / t_f | Rise and fall time CLK signal (20% to 80%) | | | 3 | ns |
| $duty_{CLK}$ | Duty cycle CLK at $V_{DD} / 2$ | 40% | | 60% | |

7.7 SDA/SCL Timing Requirements

| (See Figure 5) | | STANDARD MODE | | FAST MODE | | UNIT |
|-----------------|--|---------------|------|-----------|-----|---------|
| | | MIN | MAX | MIN | MAX | |
| f_{SCL} | SCL clock frequency | 0 | 100 | 0 | 400 | kHz |
| $t_{su}(START)$ | START setup time (SCL high before SDA low) | 4.7 | | 0.6 | | μs |
| $t_h(START)$ | START hold time (SCL low after SDA low) | 4 | | 0.6 | | μs |
| $t_w(SCLL)$ | SCL low-pulse duration | 4.7 | | 1.3 | | μs |
| $t_w(SCLH)$ | SCL high-pulse duration | 4 | | 0.6 | | μs |
| $t_h(SDA)$ | SDA hold time (SDA valid after SCL low) | 0 | 3.45 | 0 | 0.9 | μs |
| $t_{su}(SDA)$ | SDA setup time | 250 | | 100 | | ns |
| t_r | SCL/SDA input rise time | | 1000 | | 300 | ns |
| t_f | SCL/SDA input fall time | | 300 | | 300 | ns |
| $t_{su}(STOP)$ | STOP setup time | 4 | | 0.6 | | μs |
| t_{BUS} | Bus free time between a STOP and START condition | 4.7 | | 1.3 | | μs |

7.8 EEPROM Specification

| | | MIN | TYP | MAX | UNIT |
|-------|------------------------------|-----|------|-----|--------|
| EEcyc | Programming cycles of EEPROM | 100 | 1000 | | cycles |
| EEret | Data retention | 10 | | | years |

7.9 Typical Characteristics

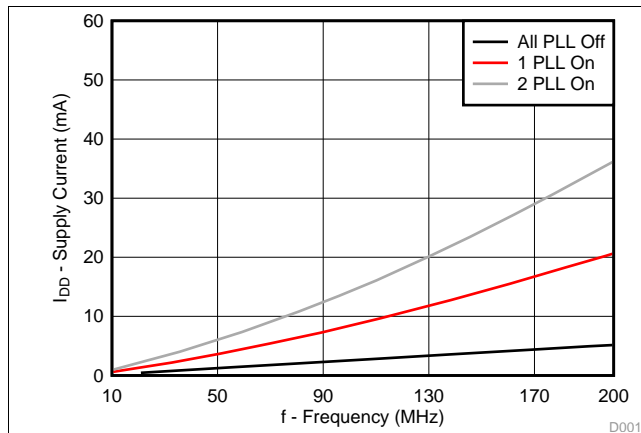


Figure 1. Supply Current vs PLL Frequency

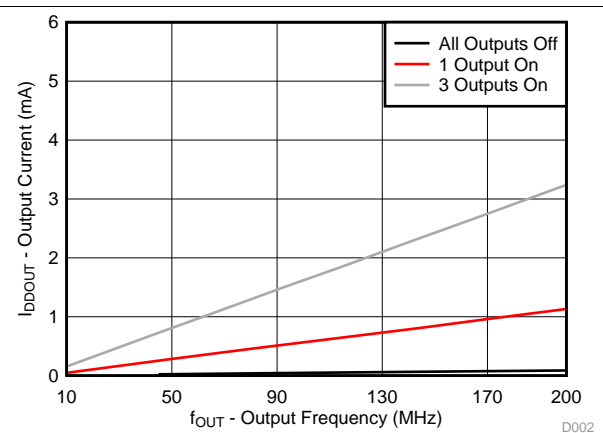


Figure 2. Output Current vs Output Frequency

8 Parameter Measurement Information

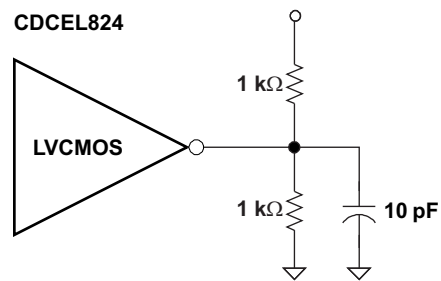


Figure 3. Test Load

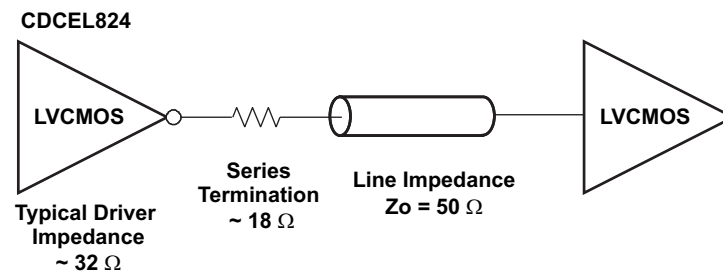


Figure 4. Test Load for 50-Ω Board Environment

9 Detailed Description

9.1 Overview

The CDCEL824 is a modular PLL-based low-cost, high-performance, programmable clock synthesizer, multiplier, and divider. It generates up to four output clocks from a single input frequency. Each output can be programmed in-system for any clock frequency up to 201 MHz, using up to two independent configurable PLLs.

The CDCEL824 has a separate output supply pins, V_{DDOUT} , which are 1.8 V.

The input accepts an external crystal or LVCMOS clock signal. In case of a crystal input, an on-chip load capacitor is adequate for most applications. The value of the load capacitor is programmable from 0 pF to 20 pF.

The deep M/N divider ratio allows the generation of zero-ppm audio/video, networking (WLAN, *Bluetooth*, Ethernet, GPS) or interface (USB, IEEE1394, memory stick) clocks from a 27-MHz reference input frequency, for example.

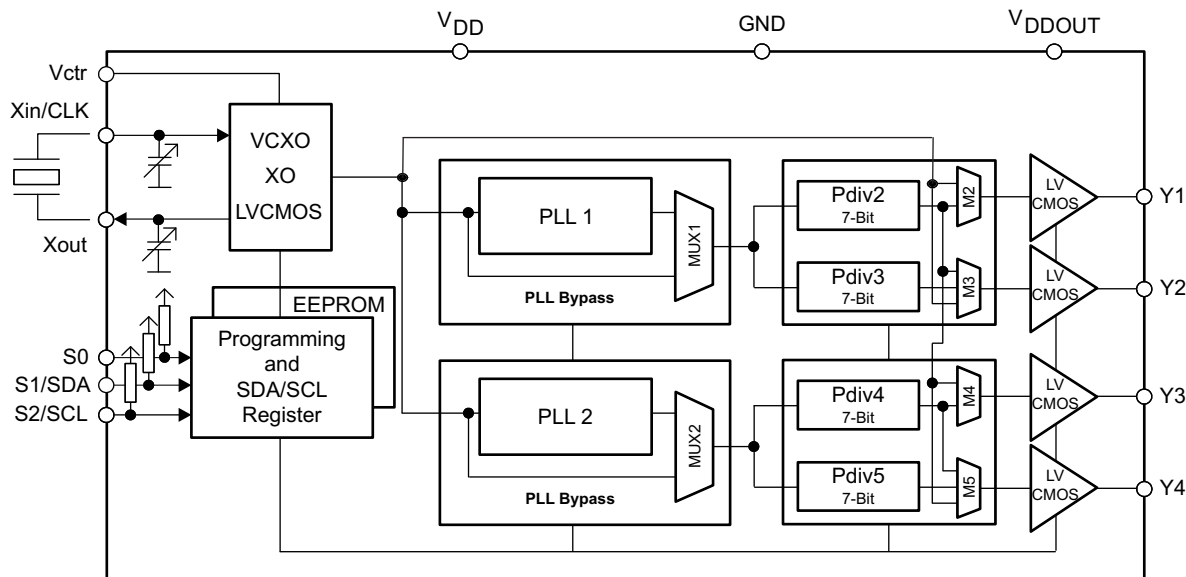
Based on the PLL frequency and the divider settings, the internal loop filter components are automatically adjusted to achieve high stability and optimized jitter transfer characteristic of each PLL.

The device supports nonvolatile EEPROM programming for easy customization of the device in the application. It is preset to a factory default configuration and can be reprogrammed to a different application configuration before it goes onto the PCB or reprogrammed by in-system programming. All device settings are programmable through the SDA/SCL bus, a 2-wire serial interface.

Three, free programmable control inputs, S0, S1, and S2, can be used to select different frequencies, or other control features like outputs disable to low, outputs in high-impedance state, power down, PLL bypass, and so forth.

The CDCx824 operates in a 1.8-V environment. It operates in a temperature range of -40°C to 85°C .

9.2 Functional Block Diagram



9.3 Feature Description

9.3.1 Control Pins Settings

The CDCEL824 has three user-definable control pins (S0, S1, and S2) which allow external control of device settings. They can be programmed to any of the following settings:

- Frequency selection → switching between any of two user-defined frequencies
- Output state selection → output configuration and power-down control

The user can predefine up to eight different control settings. Table 1 and Table 2 explain these settings.

Table 1. Control Pin Definition

| EXTERNAL CONTROL BITS | PLL1 SETTING | | | PLL2 SETTING | | | RSVD SETTING |
|-----------------------|-------------------------|----------|------------------------|-------------------------|----------|------------------------|--------------|
| Control function | PLL frequency selection | Reserved | Output Y1/Y2 selection | PLL frequency selection | Reserved | Output Y3/Y4 selection | Reserved |

Table 2. PLL Setting (Can Be Selected for Each PLL Individual)⁽¹⁾

| FREQUENCY SELECTION ⁽²⁾ | |
|---|------------|
| FSx | FUNCTION |
| 0 | Frequency0 |
| 1 | Frequency1 |
| OUTPUT SELECTION ⁽³⁾ (Y1 ... Y4) | |
| YxYx | FUNCTION |
| 0 | State0 |
| 1 | State1 |

(1) Center/down-spread, Frequency0/1 and State0/1 are user-definable in the PLLx configuration register.

(2) Frequency0 and Frequency1 can be any frequency within the specified f_{VCO} range.

(3) State0/1 selection is valid for both outputs of the corresponding PLL module and can be power down, high-impedance state, low, or active

SDA/S1 and SCL/S2 pins of the CDCEL824 are dual-function pins. In the default configuration, they are predefined as the SDA/SCL serial programming interface. They can be programmed to control pins (S1/S2) by setting the relevant bits in the EEPROM. Note that the changes of the bits in the control register (bit [6] of byte 02h) have no effect until they are written into the EEPROM.

Once they are set as control pins, the serial programming interface is no longer available. However, if V_{DDOUT} is forced to GND, the two control pins, S1 and S2, temporally act as serial programming pins (SDA/SCL).

S0 is not a multi-use pin; it is a control pin only.

9.3.2 SDA/SCL Serial Interface

This section describes the SDA/SCL interface of the CDCEL824 device. The CDCEL824 operates as a slave device of the 2-wire serial SDA/SCL bus, compatible with the popular SMBus or I²C specification. It operates in the standard-mode transfer (up to 100 kbit/s) and fast-mode transfer (up to 400 kbit/s) and supports 7-bit addressing.

The SDA/S1 and SCL/S2 pins of the CDCEL824 are dual-function pins. In the default configuration they are used as SDA/SCL serial programming interface. They can be reprogrammed as general-purpose control pins, S1 and S2, by changing the corresponding EEPROM setting, byte 02h, bit [6].

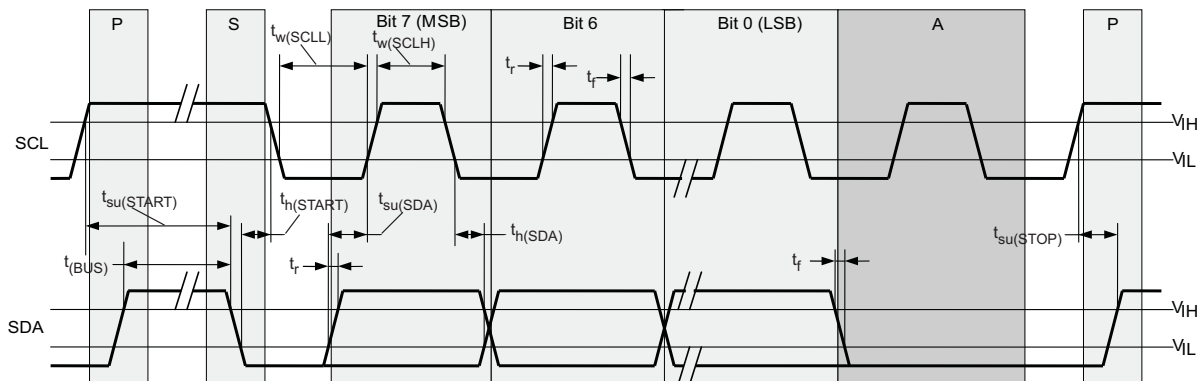


Figure 5. Timing Diagram for SDA/SCL Serial Control Interface

9.3.3 SDA/SCL Hardware Interface

Figure 6 shows how the CDCEL824 clock synthesizer is connected to the SDA/SCL serial interface bus. Multiple devices can be connected to the bus, but the speed may need to be reduced (400 kHz is the maximum) if many devices are connected.

Note that the pullup resistors (R_p) depend on the supply voltage, bus capacitance, and number of connected devices. The recommended pullup value is 4.7 k Ω . It must meet the minimum sink current of 3 mA at $V_{OLmax} = 0.4$ V for the output stages (for more details see the SMBus or I²C Bus specification).

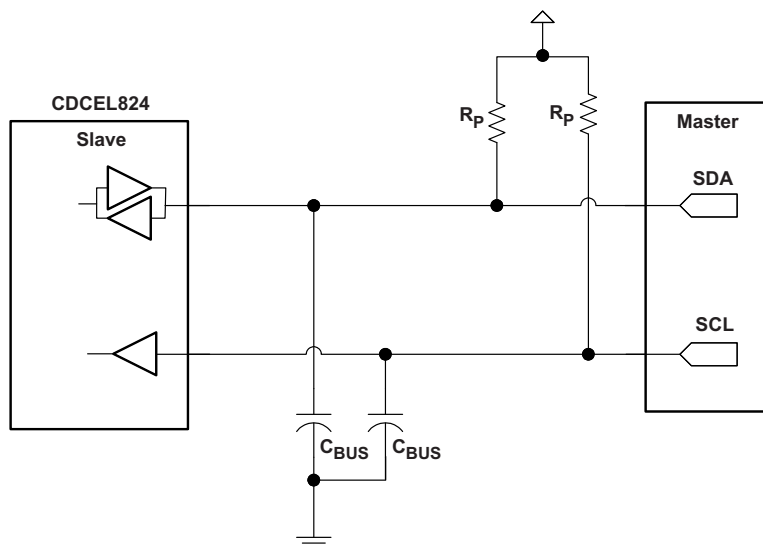


Figure 6. SDA/SCL Hardware Interface

CDCEL824

ZHCSEA7A – JUNE 2015 – REVISED SEPTEMBER 2015

www.ti.com.cn

9.4 Device Functional Modes

9.4.1 Default Device Setting

The internal EEPROM of CDCEL824 is preconfigured as shown in Figure 7. The input frequency is passed through the output as a default. This allows the device to operate in default mode without the extra production step of programming it. The default setting appears after power is supplied or after a power-down/up sequence until it is reprogrammed by the user to a different application configuration. A new register setting is programmed via the serial SDA/SCL interface.

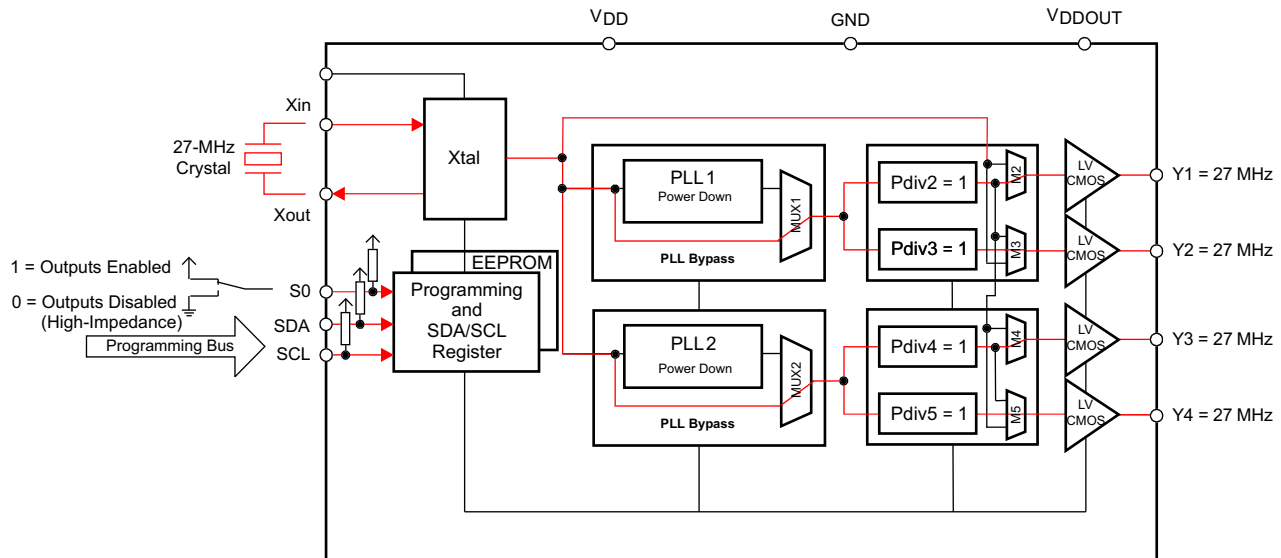


Figure 7. Preconfiguration of CDCEL824 Internal EEPROM

Table 3 shows the factory default setting for the control terminal register (external control pins). Note that even though eight different register settings are possible, in default configuration, only the first two settings (0 and 1) can be selected with S0, as S1 and S2 are configured as programming pins in the default mode.

Table 3. Factory Default Settings for Control Terminal Register⁽¹⁾

| EXTERNAL CONTROL PINS | | | PLL1 SETTINGS | | PLL2 SETTINGS | |
|-----------------------|------------------------|----|---------------------|----------------------|---------------------|----------------------|
| | | | FREQUENCY SELECTION | OUTPUT SELECTION | FREQUENCY SELECTION | OUTPUT SELECTION |
| S2 | S1 | S0 | FS1 | Y1Y2 | FS2 | Y2Y3 |
| SCL (I2C) | SDA (I ² C) | 0 | f _{VCO1_0} | High-impedance state | f _{VCO2_0} | High-impedance state |
| SCL (I2C) | SDA (I ² C) | 1 | f _{VCO1_0} | Enabled | f _{VCO2_0} | Enabled |

- (1) S1 is SDA and S2 is SCL in default mode or when programmed (SPICON bit 6 of register 2 set to 0). They do not have any control-pin function but they are internally interpreted as if S1 = 0 and S2 = 0. S0, however, is a control pin which in the default mode switches all outputs ON or OFF (as previously predefined).

9.5 Programming

9.5.1 Data Protocol

The device supports *Byte Write and Byte Read* and *Block Write and Block Read* operations.

For *Byte Write/Read* operations, the system controller can individually access addressed bytes.

For *Block Write/Read* operations, the bytes are accessed in sequential order from lowest to highest byte (with most-significant bit first) with the ability to stop after any complete byte has been transferred. The numbers of bytes read out are defined by byte count in the generic configuration register. At the *Block Read* instruction, all bytes defined in the byte count must be read out to finish the read cycle correctly.

Once a byte has been sent, it is written into the internal register and is effective immediately. This applies to each transferred byte regardless of whether this is a *Byte Write* or a *Block Write* sequence.

If the EEPROM write cycle is initiated, the internal SDA registers are written into the EEPROM. During this write cycle, data is not accepted at the SDA/SCL bus until the write cycle is completed. However, data can be read out during the programming sequence (*Byte Read* or *Block Read*). The programming status can be monitored by *EEPIP*, byte 01h–bit 6.

The offset of the indexed byte is encoded in the command code, as described in [Table 4](#).

Table 4. Slave Receiver Address (7 Bits)

| DEVICE | A6 | A5 | A4 | A3 | A2 | A1 ⁽¹⁾ | A0 ⁽¹⁾ | R/W |
|----------|----|----|----|----|----|-------------------|-------------------|-----|
| CDCEL824 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1/0 |

(1) Address bits A0 and A1 are programmable via the SDA/SCL bus (byte 01, bit [1:0]). This allows addressing up to four devices connected to the same SDA/SCL bus. The least-significant bit of the address byte designates a write or read operation.

9.5.2 Command Code Definition

Table 5. Command Code Definition

| BIT | DESCRIPTION |
|-------|--|
| 7 | 0 = <i>Block Read</i> or <i>Block Write</i> operation 1 = <i>Byte Read</i> or <i>Byte Write</i> operation |
| (6:0) | Byte offset for <i>Byte Read</i> , <i>Block Read</i> , <i>Byte Write</i> and <i>Block Write</i> operations. |

9.5.3 Generic Programming Sequence

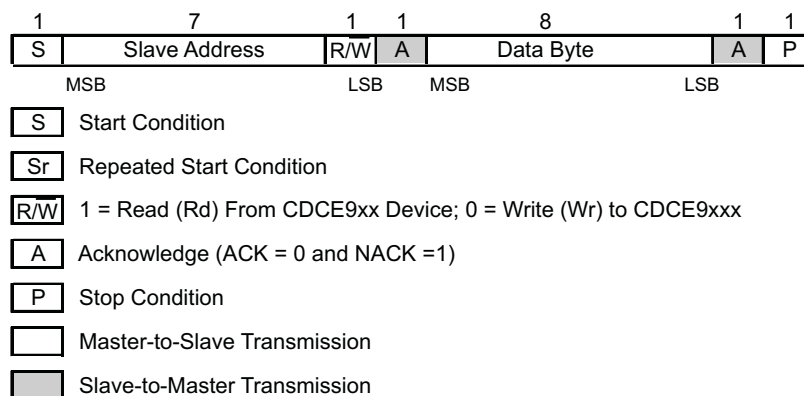


Figure 8. Generic Programming Sequence

9.5.4 Byte Write Programming Sequence



Figure 9. Byte Write Protocol

9.5.5 Byte Read Programming Sequence

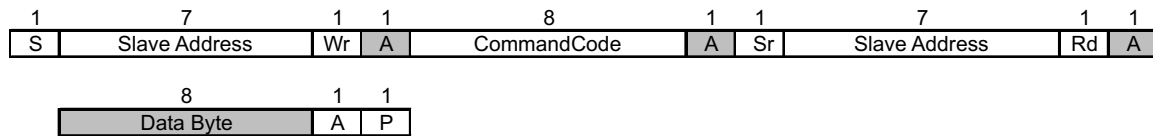
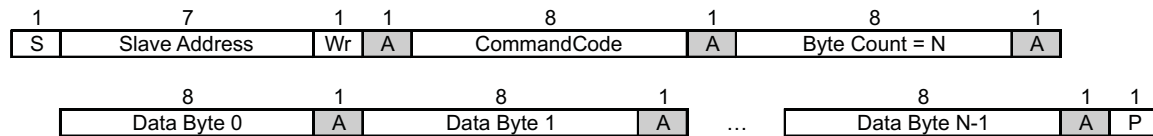


Figure 10. Byte Read Protocol

9.5.6 Block Write Programming Sequence



- (1) Data byte 0 bits [7:0] is reserved for Revision Code and Vendor Identification. Also, it is used for internal test purpose and should not be overwritten.

Figure 11. Block Write Protocol

9.5.7 Block Read Programming Sequence

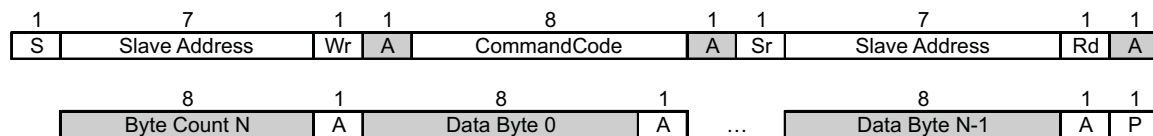


Figure 12. Block Read Protocol

9.6 Register Maps

9.6.1 SDA/SCL Configuration Registers

The clock input, control pins, PLLs, and output stages are user configurable. The following tables and explanations describe the programmable functions of the CDCEL824. All settings can be manually written into the device via the SDA/SCL bus or easily programmed by using the TI Pro-Clock™ software.

Table 6. SDA/SCL Registers

| ADDRESS OFFSET | REGISTER DESCRIPTION | TABLE |
|----------------|--------------------------------|--------------------------|
| 00h | Generic configuration register | Table 8 |
| 10h | PLL1 configuration register | Table 9 |
| 20h | PLL2 configuration register | Table 10 |

The grey-highlighted bits, described in the Configuration Registers tables in the following pages, belong to the Control Terminal Register. The user can predefine up to eight different control settings. These settings then can be selected by the external control pins, S0, S1, and S2. [Table 7](#) explains the corresponding bit assignment between the Control Terminal Register and the Configuration Registers.

Table 7. Configuration Register, External Control Terminals

| | EXTERNAL CONTROL PINS | | | PLL1 SETTINGS | | PLL2 SETTINGS | |
|---|-------------------------------|----|----|---------------------|------------------|---------------------|------------------|
| | | | | FREQUENCY SELECTION | OUTPUT SELECTION | FREQUENCY SELECTION | OUTPUT SELECTION |
| | S2 | S1 | S0 | FS1 | Y1Y2 | FS2 | Y3Y4 |
| 0 | 0 | 0 | 0 | FS1_0 | Y1Y2_0 | FS2_0 | Y3Y4_0 |
| 1 | 0 | 0 | 1 | FS1_1 | Y1Y2_1 | FS2_1 | Y3Y4_1 |
| 2 | 0 | 1 | 0 | FS1_2 | Y1Y2_2 | FS2_2 | Y3Y4_2 |
| 3 | 0 | 1 | 1 | FS1_3 | Y1Y2_3 | FS2_3Reserved | Reserved |
| 4 | 1 | 0 | 0 | FS1_4 | Y1Y2_4 | FS2_4Reserved | Reserved |
| 5 | 1 | 0 | 1 | FS1_5 | Y1Y2_5 | FS2_5 | Y3Y4_5 |
| 6 | 1 | 1 | 0 | FS1_6 | Y1Y2_6 | FS2_6 | Y3Y4_6 |
| 7 | 1 | 1 | 1 | FS1_7 | Y1Y2_7 | FS2_7 | Y3Y4_7 |
| | Address offset ⁽¹⁾ | | | 13h | 15h | 23h | 25h |

(1) Address offset refers to the byte address in the configuration register in [Table 8](#), [Table 9](#), and [Table 10](#).

CDCEL824

ZHCSEA7A – JUNE 2015 – REVISED SEPTEMBER 2015

www.ti.com.cn
Table 8. Generic Configuration Register

| OFFSET ⁽¹⁾ | BIT ⁽²⁾ | ACRONYM | DEFAULT ⁽³⁾ | DESCRIPTION |
|-----------------------|--------------------|-----------|------------------------|--|
| 00h | 7 | E_EL | 0b | Device identification (read-only): 0 is CDCEL824 (1.8 V out) |
| | 6:4 | RID | Xb | Revision identification number (read-only) |
| | 3:0 | VID | 1h | Vendor identification number (read-only) |
| 01h | 7 | – | 0b | Reserved – always write 0 |
| | 6 | EEPIP | 0b | EEPROM programming Status4: ⁽⁴⁾ (read-only) 0 – EEPROM programming is completed 1 – EEPROM is in programming mode |
| | 5 | EELOCK | 0b | Permanently lock EEPROM data ⁽⁵⁾ 0 – EEPROM is not locked 1 – EEPROM is permanently locked |
| | 4 | PWDN | 0b | Device power down (overwrites S0/S1/S2 setting; configuration register settings are unchanged) Note: PWDN cannot be set to 1 in the EEPROM. 0 – Device active (all PLLs and all outputs are enabled) 1 – Device power down (all PLLs in power down and all outputs in high-impedance state) |
| | 3:2 | INCLK | 00b | Input clock selection: 00 – Xtal 01 – VCXO 10 – LVCMOS 1 – Reserved |
| | 1:0 | SLAVE_ADR | 00b | Address bits A0 and A1 of the slave receiver address |
| 02h | 7 | M1 | 0b | RSVD 0 – Input clock 1 – PLL1 clock |
| | 6 | SPICON | 0b | Operation mode selection for pins 14/15 ⁽⁶⁾ 0 – Serial programming interface SDA (pin 15) and SCL (pin 14) 1 – Control pins S1 (pin 15) and S2 (pin 14) |
| | 5:4 | RSVD | 01b | RSVD Reserved |
| | 3:2 | RSVD | 01b | |
| | 1:0 | RSVD | 001h | RSVD Reserved |
| 03h | 7:0 | RSVD | | |
| 04h | 7 | Reserved | 0b | RSVD Reserved |
| | 6 | Reserved | 0b | |
| | 5 | Reserved | 0b | |
| | 4 | Reserved | 0b | |
| | 3 | Reserved | 0b | |
| | 2 | Reserved | 0b | |
| | 1 | Reserved | 0b | |

(1) Writing data beyond 30h may affect device function.

(2) All data transferred with the MSB first

(3) Unless customer-specific setting

(4) During EEPROM programming, no data is allowed to be sent to the device via the SDA/SCL bus until the programming sequence is completed. Data, however, can be read out during the programming sequence (*Byte Read* or *Block Read*).

(5) If this bit is set to high in the EEPROM, the actual data in the EEPROM is permanently locked. No further programming is possible. Data, however can still be written via the SDA/SCL bus to the internal register to change device function on the fly. But new data can no longer be saved to the EEPROM. EELOCK is effective only if written into the EEPROM.

(6) Selection of *control pins* is effective only if written into the EEPROM. Once written into the EEPROM, the serial programming pins are no longer available. However, if V_{DDOUT} is forced to GND, the two control pins, S1 and S2, temporally act as serial programming pins (SDA/SCL), and the two slave receiver address bits are reset to A0 = 0 and A1 = 0.

Table 8. Generic Configuration Register (continued)

| OFFSET ⁽¹⁾ | BIT ⁽²⁾ | ACRONYM | DEFAULT ⁽³⁾ | DESCRIPTION |
|-----------------------|--------------------|---------|------------------------|---|
| 05h | 7:3 | XCSEL | 0Ah | Crystal load-capacitor selection ⁽⁷⁾ 00h – 0 pF 01h – 1 pF 02h – 2 pF : 14h to 1Fh – 20 pF |
| | 2:0 | | 0b | Reserved – do not write other than 0. |
| 06h | 7:1 | BCOUNT | 30h | 7-bit byte count (defines the number of bytes which will be sent from this device at the next <i>Block Read</i> transfer); all bytes must be read out to correctly finish the read cycle. |
| | 0 | EEWRITE | 0b | Initiate EEPROM write cycle ⁽⁸⁾ 0 – No EEPROM write cycle 1 – Start EEPROM write cycle (internal registers are saved to the EEPROM) |
| 07h-0Fh | | — | 0h | Reserved – do not write other than 0 |

- (7) The internal load capacitor (C1, C2) must be used to achieve the best clock performance. External capacitors should be used only to finely adjust C_L by a few picofarads. The value of C_L can be programmed with a resolution of 1 pF for a crystal load range of 0 pF to 20 pF. For $C_L > 20$ pF, use additional external capacitors. Also, the value of the device input capacitance has to be considered which always adds 1.5 pF (6 pF/2 pF) to the selected C_L . For more information about VCXO configuration and crystal recommendation, see application report [SCAA085](#).
- (8) Note: The EEPROM WRITE bit must be sent last. This ensures that the content of all internal registers are stored in the EEPROM. The EEWRITE cycle is initiated with the rising edge of the EEWRITE bit. A static level-high does not trigger an EEPROM WRITE cycle. The EEWRITE bit must be reset to low after the programming is completed. The programming status can be monitored by reading out EEPIP. If EELOCK is set to high, no EEPROM programming is possible.

CDCEL824

ZHCSEA7A – JUNE 2015 – REVISED SEPTEMBER 2015

www.ti.com.cn
Table 9. PLL1 Configuration Register

| OFFSET ⁽¹⁾ | BIT ⁽²⁾ | ACRONYM | DEFAULT ⁽³⁾ | DESCRIPTION | |
|-----------------------|--------------------|----------|------------------------|--|--|
| 10h | 7:0 | Reserved | 00000000b | Reserved | |
| 11h | 7:0 | Reserved | 00000000b | Reserved | |
| 12h | 7:0 | Reserved | 00000000b | Reserved | |
| 13h | 7 | FS1_7 | 0b | FS1_x: PLL1 frequency selection ⁽⁴⁾ | |
| | 6 | FS1_6 | 0b | | 0 – f_{VCO1_0} (predefined by PLL1_0 – multiplier/divider value) 1 – f_{VCO1_1} (predefined by PLL1_1 – multiplier/divider value) |
| | 5 | FS1_5 | 0b | | |
| | 4 | FS1_4 | 0b | | |
| | 3 | FS1_3 | 0b | | |
| | 2 | FS1_2 | 0b | | |
| | 1 | FS1_1 | 0b | | |
| | 0 | FS1_0 | 0b | | |
| 14h | 7 | MUX1 | 1b | PLL1 multiplexer: | 0 – PLL1 1 – PLL1 bypass (PLL1 is in power down) |
| | 6 | M2 | 1b | Output Y1 multiplexer: | 0 – bypass 1 – Pdiv2 |
| | 5:4 | M3 | 10b | Output Y2 multiplexer: | 00 – bypass 01 – Pdiv2-divider 10 – Pdiv3-divider 11 – Reserved |
| | 3:2 | Y1Y2_ST1 | 11b | Y1, Y2-state0/1definition: | 00 – Y1/Y2 disabled to high-impedance state (PLL1 is in power down) 01 – Y1/Y2 disabled to high-impedance state (PLL1 on) 10 – Y1/Y2 disabled to low (PLL1 on) 11 – Y1/Y2 enabled (normal operation, PLL1 on) |
| | 1:0 | Y1Y2_ST0 | 01b | | |

(1) Writing data beyond 30h may adversely affect device function.

(2) All data is transferred MSB-first.

(3) Unless a custom setting is used

Table 9. PLL1 Configuration Register (continued)

| OFFSET ⁽¹⁾ | BIT ⁽²⁾ | ACRONYM | DEFAULT ⁽³⁾ | DESCRIPTION |
|-----------------------|--------------------|----------------|------------------------|--|
| 15h | 7 | Y1Y2_7 | 0b | Y1Y2_x output state selection ⁽⁴⁾ 0 – state0 (predefined by Y1Y2_ST0) 1 – state1 (predefined by Y1Y2_ST1) |
| | 6 | Y1Y2_6 | 0b | |
| | 5 | Y1Y2_5 | 0b | |
| | 4 | Y1Y2_4 | 0b | |
| | 3 | Y1Y2_3 | 0b | |
| | 2 | Y1Y2_2 | 0b | |
| | 1 | Y1Y2_1 | 1b | |
| | 0 | Y1Y2_0 | 0b | |
| 16h | 7 | Reserved | 0b | RSVD Reserved |
| | 6:0 | Pdiv2 | 01h | 7-bit Y1-output-divider Pdiv2: 0 – Reset and in standby 1 to 127 – Divider value |
| 17h | 7 | — | 0b | Reserved – do not write others than 0 |
| | 6:0 | Pdiv3 | 01h | 7-bit Y2-output-divider Pdiv3: 0 – Reset and in standby 1 to 127 – Divider value |
| 18h | 7:0 | PLL1_0N [11:4] | 004h | PLL1_0 ⁽⁴⁾ : 30-bit multiplier/divider value for frequency f _{VCO1_0} (for more information, see the PLL Multiplier/Divider Definition paragraph). |
| 19h | 7:4 | PLL1_0N [3:0] | | |
| | 3:0 | PLL1_0R [8:5] | 000h | |
| 1Ah | 7:3 | PLL1_0R[4:0] | | |
| | 2:0 | PLL1_0Q [5:3] | 10h | |
| 1Bh | 7:5 | PLL1_0Q [2:0] | | |
| | 4:2 | PLL1_0P [2:0] | 010b | |
| | 1:0 | VCO1_0_RANGE | 00b | f _{VCO1_0} range selection: 00 – f _{VCO1_0} < 125 MHz 01 – 125 MHz ≤ f _{VCO1_0} < 150 MHz 10 – 150 MHz ≤ f _{VCO1_0} < 175 MHz 11 – f _{VCO1_0} ≥ 175 MHz |
| 1Ch | 7:0 | PLL1_1N [11:4] | 004h | PLL1_1 ⁽⁴⁾ : 30-bit multiplier/divider value for frequency f _{VCO1_1} (for more information see the PLL Multiplier/Divider Definition paragraph) |
| 1Dh | 7:4 | PLL1_1N [3:0] | | |
| | 3:0 | PLL1_1R [8:5] | 000h | |
| 1Eh | 7:3 | PLL1_1R[4:0] | | |
| | 2:0 | PLL1_1Q [5:3] | 10h | |
| 1Fh | 7:5 | PLL1_1Q [2:0] | | |
| | 4:2 | PLL1_1P [2:0] | 010b | |
| | 1:0 | VCO1_1_RANGE | 00b | f _{VCO1_1} range selection: 00 – f _{VCO1_1} < 125 MHz 01 – 125 MHz ≤ f _{VCO1_1} < 150 MHz 10 – 150 MHz ≤ f _{VCO1_1} < 175 MHz 11 – f _{VCO1_1} ≥ 175 MHz |

(4) PLL settings limits: $16 \leq q \leq 63$, $0 \leq p \leq 7$, $0 \leq r \leq 511$, $0 < N < 4096$

CDCEL824

ZHCSEA7A – JUNE 2015 – REVISED SEPTEMBER 2015

www.ti.com.cn
Table 10. PLL2 Configuration Register

| OFFSET ⁽¹⁾ | BIT ⁽²⁾ | ACRONYM | DEFAULT ⁽³⁾ | DESCRIPTION |
|-----------------------|--------------------|----------|------------------------|--|
| 20h | 7:0 | Reserved | 0000000b | Reserved |
| 21h | 7:0 | Reserved | 0000000b | Reserved |
| 22h | 7:0 | Reserved | 0000000b | Reserved |
| 23h | 7 | FS2_7 | 0b | FS2_x: PLL2 frequency selection ⁽⁴⁾ 0 – f_{VCO2_0} (predefined by PLL2_0 – multiplier/divider value) 1 – f_{VCO2_1} (predefined by PLL2_1 – multiplier/divider value) |
| | 6 | FS2_6 | 0b | |
| | 5 | FS2_5 | 0b | |
| | 4 | FS2_4 | 0b | |
| | 3 | FS2_3 | 0b | |
| | 2 | FS2_2 | 0b | |
| | 1 | FS2_1 | 0b | |
| | 0 | FS2_0 | 0b | |
| 24h | 7 | MUX2 | 1b | PLL2 multiplexer: 0 – PLL2 1 – PLL2 bypass (PLL2 is in power down) |
| | 6 | M4 | 1b | Output Y3 multiplexer: 0 – Pdiv2 1 – Pdiv4 |
| | 5:4 | M5 | 10b | Output Y4 multiplexer: 00 – Pdiv2-divider 01 – Pdiv4-divider 10 – Pdiv5-divider 11 – Reserved |
| | 3:2 | Y3Y4_ST1 | 11b | Y3, Y4-State0/1definition: 00 – Y3/Y4 disabled to high-impedance state (PLL2 is in power down) 01 – Y3/Y4 disabled to high-impedance state (PLL2 on) 10 – Y3/Y4 disabled to low (PLL2 on) 11 – Y3/Y4 enabled (normal operation, PLL2 on) |
| | 1:0 | Y3Y4_ST0 | 01b | |

(1) Writing data beyond 30h may adversely affect device function.

(2) All data is transferred MSB-first.

(3) Unless a custom setting is used

Table 10. PLL2 Configuration Register (continued)

| OFFSET ⁽¹⁾ | BIT ⁽²⁾ | ACRONYM | DEFAULT ⁽³⁾ | DESCRIPTION | |
|-----------------------|--------------------|----------------|------------------------|--|--|
| 25h | 7 | Y3Y4_7 | 0b | Y3Y4_x output state selection ⁽⁴⁾ 0 – state0 (predefined by Y3Y4_ST0) 1 – state1 (predefined by Y3Y4_ST1) | |
| | 6 | Y3Y4_6 | 0b | | |
| | 5 | Y3Y4_5 | 0b | | |
| | 4 | Y3Y4_4 | 0b | | |
| | 3 | Y3Y4_3 | 0b | | |
| | 2 | Y3Y4_2 | 0b | | |
| | 1 | Y3Y4_1 | 1b | | |
| | 0 | Y3Y4_0 | 0b | | |
| 26h | 7 | Reserved | 0b | Reserved 0 – Down 1 – Center | |
| | 6:0 | Pdiv4 | 01h | 7-Bit Y3-output-divider Pdiv4: 0 – Reset and in standby 1 to 127 – Divider value | |
| 27h | 7 | — | 0b | Reserved – do not write others than 0 | |
| | 6:0 | Pdiv5 | 01h | 7-bit Y4-output-divider Pdiv5: 0 – Reset and in standby 1 to 127 – Divider value | |
| 28h | 7:0 | PLL2_0N [11:4] | 004h | PLL2_0 ⁽⁴⁾ : 30-Bit Multiplier/Divider value for frequency f _{VCO2_0} (for more information see the PLL Multiplier/Divider Definition paragraph) | |
| 29h | 7:4 | PLL2_0N [3:0] | | | |
| | 3:0 | PLL2_0R [8:5] | 000h | | |
| 2Ah | 7:3 | PLL2_0R[4:0] | 10h | | |
| | 2:0 | PLL2_0Q [5:3] | | | |
| 2Bh | 7:5 | PLL2_0Q [2:0] | 010b | | |
| | 4:2 | PLL2_0P [2:0] | | | |
| | 1:0 | VCO2_0_RANGE | 00b | | f _{VCO2_0} range selection: 00 – f _{VCO2_0} < 125 MHz 01 – 125 MHz ≤ f _{VCO2_0} < 150 MHz 10 – 150 MHz ≤ f _{VCO2_0} < 175 MHz 11 – f _{VCO2_0} ≥ 175 MHz |
| 2Ch | 7:0 | PLL2_1N [11:4] | 004h | | PLL2_1 ⁽⁴⁾ : 30-bit multiplier/divider value for frequency f _{VCO2_1} (for more information see the PLL Multiplier/Divider Definition paragraph) |
| 2Dh | 7:4 | PLL2_1N [3:0] | | | |
| | 3:0 | PLL2_1R [8:5] | 000h | | |
| 2Eh | 7:3 | PLL2_1R[4:0] | 10h | | |
| | 2:0 | PLL2_1Q [5:3] | | | |
| 2Fh | 7:5 | PLL2_1Q [2:0] | 010b | | |
| | 4:2 | PLL2_1P [2:0] | | | |
| | 1:0 | VCO2_1_RANGE | 00b | f _{VCO2_1} range selection: 00 – f _{VCO2_1} < 125 MHz 01 – 125 MHz ≤ f _{VCO2_1} < 150 MHz 10 – 150 MHz ≤ f _{VCO2_1} < 175 MHz 11 – f _{VCO2_1} ≥ 175 MHz | |

(4) PLL settings limits: $16 \leq q \leq 63$, $0 \leq p \leq 7$, $0 \leq r \leq 511$, $0 < N < 4096$

Typical Application (continued)

10.2.1 Design Requirements

For Laser distance meter applications, if heterodyne technique is used as mentioned in [Typical Application](#), it is shown that:

$$\text{Maximum Measurement Range equals: } R = \frac{c}{2f_o} \quad (1)$$

$$\text{And best error achievable in measurement: } \Delta d = \frac{c}{2} \frac{f_I}{f_o} \frac{1}{f_c} \quad (2)$$

That means lower RF frequency allows for longer range, while lower ratio $\frac{f_I}{f_o}$ (higher RF frequency and lower IF frequency) gives lower error.

The values of intermediate, RF, and counter frequency should be chosen according to design targets of the maximum range and maximum tolerable error. Typically multiple consecutive measurements with multiple RF frequencies are carried on to resolve the trade-off between the accuracy and the maximum range.

10.2.2 Detailed Design Procedure

10.2.2.1 PLL Multiplier/Divider Definition

At a given input frequency (f_{IN}), the output frequency (f_{OUT}) of the CDCEL824 can be calculated:

$$f_{OUT} = \frac{f_{IN}}{P_{div}} \times \frac{N}{M}$$

where

- M (1 to 511) and N (1 to 4095) are the multiplier/divide values of the PLL
- Pdiv (1 to 127) is the output divider. (3)

The target VCO frequency (f_{VCO}) of each PLL can be calculated:

$$f_{VCO} = f_{IN} \times \frac{N}{M} \quad (4)$$

The PLL internally operates as fractional divider and needs the following multiplier/divider settings:

$$NP = 4 - \text{int} \left(\log_2 \frac{N}{M} \right) \text{ [if } P < 0 \text{ then } P = 0] \quad Q = \text{int} \left(\frac{N'}{M} \right) \quad R = N' - M \times Q$$

where

$$\begin{aligned} N' &= N \times 2^P \\ N &\geq M \\ 80 \text{ MHz} &\leq f_{VCO} \leq 200 \text{ MHz} \\ 16 &\leq q \leq 63 \\ 0 &\leq p \leq 4 \\ 0 &\leq r \leq 511 \end{aligned}$$

Example:

for $f_{IN} = 27 \text{ MHz}$; $M = 1$; $N = 4$; $P_{div} = 2$;

$$\begin{aligned} \rightarrow f_{OUT} &= 54 \text{ MHz} \\ \rightarrow f_{VCO} &= 108 \text{ MHz} \\ \rightarrow P &= 4 - \text{int}(\log_2 4) = 4 - 2 = 2 \\ \rightarrow N' &= 4 \times 2^2 = 16 \\ \rightarrow Q &= \text{int}(16) = 16 \\ \rightarrow R &= 16 - 16 = 0 \end{aligned}$$

for $f_{IN} = 27 \text{ MHz}$; $M = 2$; $N = 11$; $P_{div} = 2$;

$$\begin{aligned} \rightarrow f_{OUT} &= 74.25 \text{ MHz} \\ \rightarrow f_{VCO} &= 148.50 \text{ MHz} \\ \rightarrow P &= 4 - \text{int}(\log_2 5.5) = 4 - 2 = 2 \\ \rightarrow N' &= 11 \times 2^2 = 44 \\ \rightarrow Q &= \text{int}(22) = 22 \\ \rightarrow R &= 44 - 44 = 0 \end{aligned}$$

Typical Application (continued)

The values for P, Q, R, and N' are automatically calculated when using TI Pro-Clock™ software.

10.2.3 Application Curves

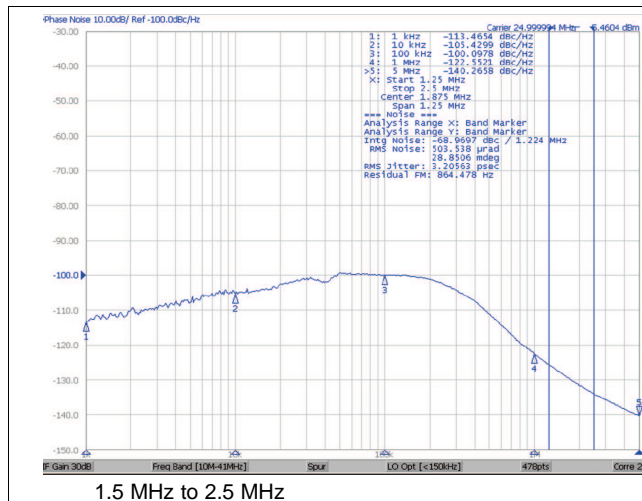


Figure 14. Phase Noise and RMS Jitter

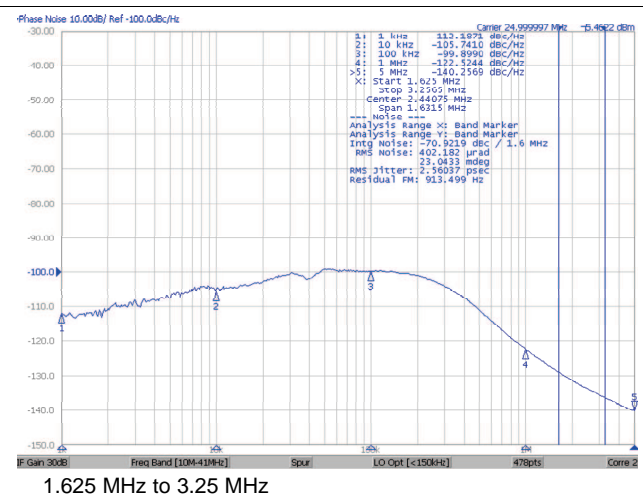


Figure 15. Phase Noise and RMS Jitter

11 Power Supply Recommendations

There is no restriction on the power-up sequence. In case VDDOUT is applied first, it is recommended to ground VDD. In case VDDOUT is powered while VDD is floating, there is a risk of high current flowing on the VDDOUT.

The device has a power-up control that is connected to the 1.8-V supply. This keeps the whole device disabled until the 1.8-V supply reaches a sufficient voltage level. Then the device switches on all internal components, including the outputs. If there is a VDDOUT available before the V_{DD} supply, the outputs will stay disabled until the VDD supply has reached a certain level.

12 Layout

12.1 Layout Guidelines

When the CDCEL824 is used as a crystal buffer, any parasitics across the crystal affects the pulling range of the VCXO. Therefore, care must be taken in placing the crystal units on the board. Crystals should be placed as close to the device as possible, ensuring that the routing lines from the crystal terminals to X_{IN} and X_{OUT} have the same length.

If possible, cut out both ground plane and power plane under the area where the crystal and the routing to the device are placed. In this area, always avoid routing any other signal line, as it could be a source of noise coupling.

Additional discrete capacitors can be required to meet the load capacitance specification of certain crystal. For example, a 10.7-pF load capacitor is not fully programmable on the chip, because the internal capacitor can range from 0 pF to 20 pF with steps of 1 pF. The 0.7-pF capacitor therefore can be discretely added on top of an internal 10 pF.

To minimize the inductive influence of the trace, it is recommended to place this small capacitor as close to the device as possible and symmetrically with respect to X_{IN} and X_{OUT}.

Figure 16 shows a conceptual layout detailing recommended placement of power supply bypass capacitors. For component side mounting, use 0402 body size capacitors to facilitate signal routing. Keep the connections between the bypass capacitors and the power supply on the device as short as possible. Ground the other side of the capacitor using a low-impedance connection to the ground plane.

12.2 Layout Example

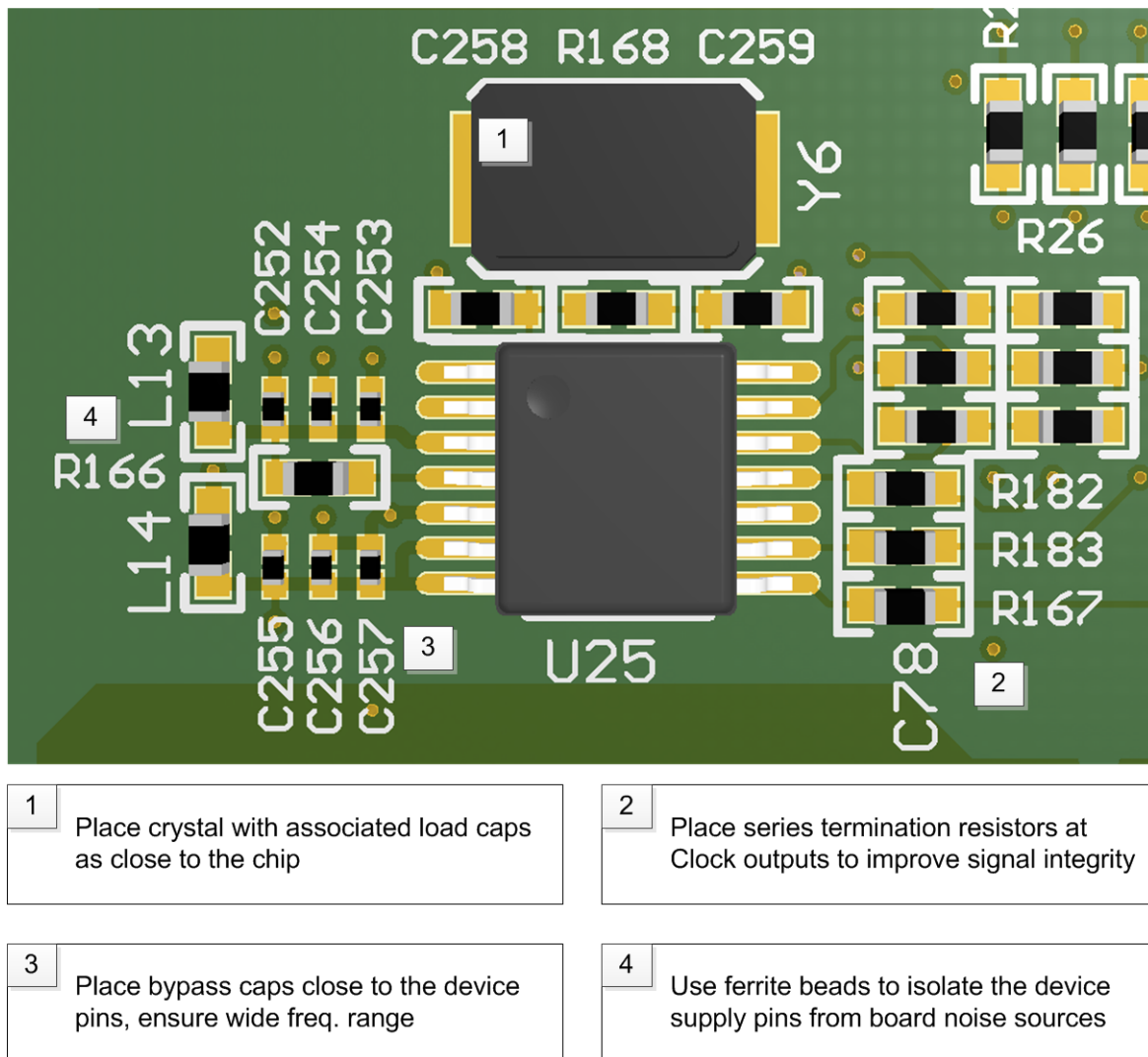


Figure 16. Board Layout

13 器件和文档支持

13.1 文档支持

13.2 社区资源

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

TI E2E™ Online Community *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

Design Support *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

13.3 商标

Pro-Clock, E2E are trademarks of Texas Instruments.

13.4 静电放电警告



这些装置包含有限的内置 ESD 保护。存储或装卸时，应将导线一起截短或将装置放置于导电泡棉中，以防止 MOS 门极遭受静电损伤。

13.5 Glossary

[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

14 机械、封装和可订购信息

以下页中包括机械、封装和可订购信息。 这些信息是针对指定器件可提供的最新数据。 这些数据会在无通知且不
对本文档进行修订的情况下发生改变。 欲获得该数据表的浏览器版本，请查阅左侧的导航栏。

PACKAGING INFORMATION

| Orderable part number | Status (1) | Material type (2) | Package Pins | Package qty Carrier | RoHS (3) | Lead finish/ Ball material (4) | MSL rating/ Peak reflow (5) | Op temp (°C) | Part marking (6) |
|-----------------------------|---------------|----------------------|-----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| CDCEL824PWR | Active | Production | TSSOP (PW) 16 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | CKEL824 |
| CDCEL824PWR.B | Active | Production | TSSOP (PW) 16 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | CKEL824 |

⁽¹⁾ **Status:** For more details on status, see our [product life cycle](#).

⁽²⁾ **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

⁽³⁾ **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

⁽⁴⁾ **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

⁽⁵⁾ **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

⁽⁶⁾ **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

Important Information and Disclaimer:The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|-------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| CDCEL824PWR | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|-------------|--------------|-----------------|------|------|-------------|------------|-------------|
| CDCEL824PWR | TSSOP | PW | 16 | 2000 | 353.0 | 353.0 | 32.0 |



4220204/B 12/2023

NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.

EXAMPLE BOARD LAYOUT

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



SOLDER MASK DETAILS

4220204/B 12/2023

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 10X

4220204/B 12/2023

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

重要通知和免责声明

TI“按原样”提供技术和可靠性数据（包括数据表）、设计资源（包括参考设计）、应用或其他设计建议、网络工具、安全信息和其他资源，不保证没有瑕疵且不做任何明示或暗示的担保，包括但不限于对适销性、与某特定用途的适用性或不侵犯任何第三方知识产权的暗示担保。

这些资源可供使用 TI 产品进行设计的熟练开发人员使用。您将自行承担以下全部责任：(1) 针对您的应用选择合适的 TI 产品，(2) 设计、验证并测试您的应用，(3) 确保您的应用满足相应标准以及任何其他安全、安保法规或其他要求。

这些资源如有变更，恕不另行通知。TI 授权您仅可将这些资源用于研发本资源所述的 TI 产品的相关应用。严禁以其他方式对这些资源进行复制或展示。您无权使用任何其他 TI 知识产权或任何第三方知识产权。对于因您对这些资源的使用而对 TI 及其代表造成的任何索赔、损害、成本、损失和债务，您将全额赔偿，TI 对此概不负责。

TI 提供的产品受 [TI 销售条款](#)、[TI 通用质量指南](#) 或 [ti.com](#) 上其他适用条款或 TI 产品随附的其他适用条款的约束。TI 提供这些资源并不会扩展或以其他方式更改 TI 针对 TI 产品发布的适用的担保或担保免责声明。除非德州仪器 (TI) 明确将某产品指定为定制产品或客户特定产品，否则其产品均为按确定价格收入目录的标准通用器件。

TI 反对并拒绝您可能提出的任何其他或不同的条款。

版权所有 © 2025，德州仪器 (TI) 公司

最后更新日期：2025 年 10 月