

# CDCE(L)925: Flexible Low Power LVCMOS Clock Generator With SSC Support for EMI Reduction

## 1 Features

- Member of Programmable Clock Generator Family
  - CDCEx913: 1-PLL, 3 Outputs
  - CDCEx925: 2-PLL, 5 Outputs
  - CDCEx925: 3-PLL, 7 Outputs
  - CDCEx949: 4-PLL, 9 Outputs
- In-System Programmability and EEPROM
  - Serial Programmable Volatile Register
  - Nonvolatile EEPROM to Store Customer Settings
- Flexible Input Clocking Concept
  - External Crystal: 8 MHz to 32 MHz
  - On-Chip VCXO: Pull Range  $\pm 150$  ppm
  - Single-Ended LVCMOS Up to 160 MHz
- Free Selectable Output Frequency Up to 230 MHz
- Low-Noise PLL Core
  - PLL Loop Filter Components Integrated
  - Low Period Jitter (Typical 60 ps)
- Separate Output Supply Pins
  - CDCE925: 3.3 V and 2.5 V
  - CDCEL925: 1.8 V
- Flexible Clock Driver
  - Three User-Definable Control Inputs [S0/S1/S2], for Example, SSC Selection, Frequency Switching, Output Enable, or Power Down
  - Generates Highly Accurate Clocks for Video, Audio, USB, IEEE1394, RFID, Bluetooth®, WLAN, Ethernet™, and GPS
  - Generates Common Clock Frequencies Used With TI-DaVinci™, OMAP™, DSPs
  - Programmable SSC Modulation
  - Enables 0-PPM Clock Generation
- 1.8-V Device Power Supply
- Wide Temperature Range:  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$
- Packaged in TSSOP
- Development and Programming Kit for Easy PLL Design and Programming (TI Pro-Clock™)

## 2 Applications

D-TVs, STBs, IP-STBs, DVD Players, DVD Recorders, and Printers

## 3 Description

The CDCE925 and CDCEL925 are modular PLL-based low-cost, high-performance, programmable clock synthesizers, multipliers, and dividers. They generate up to five output clocks from a single input frequency. Each output can be programmed in-system for any clock frequency up to 230 MHz, using up to two independent configurable PLLs.

The CDCEx925 has a separate output supply pin,  $V_{DDOUT}$ , which is 1.8 V for CDCEL925 and 2.5 V to 3.3 V for CDCE925.

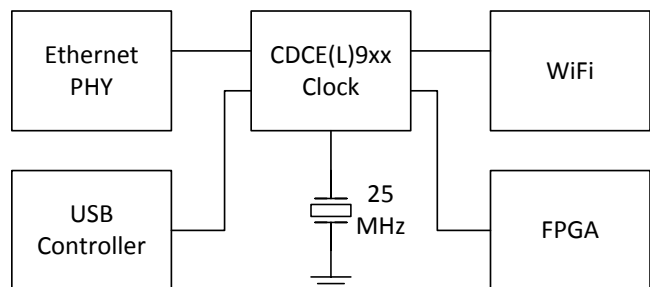
The input accepts an external crystal or LVCMOS clock signal. In case of a crystal input, an on-chip load capacitor is adequate for most applications. The value of the load capacitor is programmable from 0 to 20 pF. Additionally, an on-chip VCXO is selectable which allows synchronization of the output frequency to an external control signal, that is, PWM signal.

### Device Information<sup>(1)</sup>

| PART NUMBER | PACKAGE    | BODY SIZE (NOM)   |
|-------------|------------|-------------------|
| CDCEx925    | TSSOP (16) | 5.00 mm x 4.40 mm |

(1) For all available packages, see the orderable addendum at the end of the data sheet.

### Typical Application Schematic



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## 4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

| Changes from Revision H (August 2016) to Revision I  | Page     |
|--|----------|
| • Changed data sheet title from: <i>CDCEx925 Programmable 2-PLL VCXO Clock Synthesizer With 1.8-V, 2.5-V, 3.3-V LVCMOS Outputs</i> to: <i>CDCE(L)925: Flexible Low Power LVCMOS Clock Generator With SSC Support for EMI Reduction</i> ..... | <b>1</b> |

| Changes from Revision G (November 2011) to Revision H   | Page      |
|---|-----------|
| • Added <i>Device Information</i> table, <i>ESD Ratings</i> table, <i>Feature Description</i> section, <i>Device Functional Modes</i> , <i>Application and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section ..... | <b>1</b>  |
| • Changed $R_{\theta JB}$ from 64°C/W : to 63.63°C/W .....  | <b>6</b>  |
| • Changed $\psi_{JT}$ from 1.0°C/W : to 1.01°C/W .....  | <b>6</b>  |
| • Added $\psi_{JB}$ parameter to <i>Thermal Information</i> table .....   | <b>6</b>  |
| • Deleted figure .....  | <b>20</b> |

| Changes from Revision F (March 2010) to Revision G   | Page      |
|--|-----------|
| • Changed in Figure 9, second S to Sr .....  | <b>18</b> |
| • Changed under second where page 21 from $N' = N \times 2^p \geq M100 \text{ MHz} \leq f_{VCO} \leq 200 \text{ MHz}$ ; TO 3 lines with last line being changed to $80 \text{ MHz} \leq f_{VCO} \leq 230 \text{ MHz}$ and $0 \leq p \leq 7$ changed to $0 \leq p \leq 4$ ..... | <b>26</b> |

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**Changes from Revision E (October 2009) to Revision F** **Page**


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- Added PLL settings limits:  $16 \leq q \leq 63$ ,  $0 \leq p \leq 7$ ,  $0 \leq r \leq 511$ ,  $0 < N < 4096$  to PLL1 and PLL2 Configure Register tables ..... [21](#)
  - Added PLL settings limits:  $16 \leq q \leq 63$ ,  $0 \leq p \leq 7$ ,  $0 \leq r \leq 511$ ,  $0 < N < 511$  to PLL Multiplier/Divder Definition Section .... [25](#)
- 

**Changes from Revision D (September 2009) to Revision E** **Page**


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- Deleted sentence - A different default setting can be programmed on customer request. Contact Texas Instruments sales or marketing representative for more information. .... [15](#)
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**Changes from Revision C (December 2007) to Revision D** **Page**


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- Added Note 3: SDA and SCL can go up to 3.6 V as stated in the *Recommended Operating Conditions* table ..... [5](#)
- 

**Changes from Revision B (August 2007) to Revision C** **Page**


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- Changed all values except in add rows: Original - 108, 102, 100, 96, 34..... [6](#)
  - Changed *Generic Configuration Register* table RID From: 0h To: Xb ..... [19](#)
  - Added note to the PWDN description in *Generic Configuration Register* table ..... [19](#)
- 

**Changes from Revision A (August 2007) to Revision B** **Page**


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- Changed  $I_{DDPD}$  Power-down current Typ value from 20 to 30..... [6](#)
  - Changed  $I_L$  LVCMOS Input current Typ value from  $\pm 5$  to  $\pm 5$  Max..... [6](#)
  - Changed  $I_{IH}$  LVCMOS Input current for S0/S1/S2 value from 5 Typ to 5 Max ..... [6](#)
  - Changed  $I_{IL}$  LVCMOS Input current for S0/S1/S2 value from  $-4$  Typ to  $-4$  Max..... [6](#)
  - Changed text of Note 4 in the DEVICE CHARACTERISTIC table..... [8](#)
  - Changed Test Load for 50- $\Omega$  Board Environment..... [11](#)
  - Changed *PLL Setting* table header From: OUTPUT SELECTION (Y2 ... Y9) To: OUTPUT SELECTION (Y2 ... Y5) ..... [14](#)
  - Changed *Generic Configuration Register* table 01h Bit 7 From: For interla use – always write To: Reserved – always write ..... [19](#)
  - Changed *PLL2 Configuration Register* table PLL2\_1N [11:4] description From:  $f_{VCO1\_1}$  To:  $f_{VCO2\_1}$  ..... [23](#)
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**Changes from Original (July 2007) to Revision A** **Page**


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- Changed the data sheet status From: Product Preview To: Production data ..... [1](#)
-

## 5 Description (continued)

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.

All PLLs support SSC (spread-spectrum clocking). SSC can be center-spread or down-spread clocking, which is a common technique to reduce electromagnetic interference (EMI).

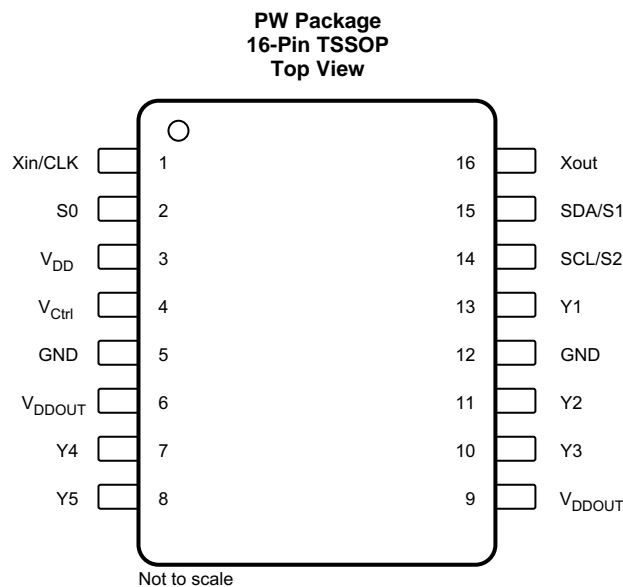
Based on the PLL frequency and the divider settings, the internal loop filter components are automatically adjusted to achieve high stability and optimized jitter transfer characteristic of each PLL.

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 change the SSC setting for lowering EMI, or other control features like outputs disable to low, outputs in high-impedance state, power down, PLL bypass, and so forth.

The CDCx925 operates in a 1.8-V environment and in a temperature range of  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

## 6 Pin Configuration and Functions



### Pin Functions

| PIN                |       | TYPE <sup>(1)</sup> | DESCRIPTION   |
|--------------------|-------|---------------------|---|
| NAME               | NO.   |                     |   |
| GND                | 5, 12 | G                   | Ground  |
| SCL/S2             | 14    | I                   | <b>SCL</b> : Serial clock input (default configuration), LVCMOS; internal pullup<br><b>S2</b> : User-programmable control input; LVCMOS inputs; internal pullup                     |
| SDA/S1             | 15    | I/O                 | <b>SDA</b> : Bidirectional serial data input/output (default configuration), LVCMOS; internal pullup<br><b>S1</b> : User-programmable control input; LVCMOS inputs; internal pullup |
| S0                 | 2     | I                   | User-programmable control input S0; LVCMOS inputs; internal pullup  |
| V <sub>Ctrl</sub>  | 4     | I                   | VCXO control voltage (leave open or pull up when not used)  |
| V <sub>DD</sub>    | 3     | P                   | 1.8-V power supply for the device   |
| V <sub>DDOUT</sub> | 6, 9  | P                   | <b>CDCEL925</b> : 1.8-V supply for all outputs  |
|                    |       |                     | <b>CDCE925</b> : 3.3-V or 2.5-V supply for all outputs  |

(1) G = Ground, I = Input, O = Output, P = Power

### Pin Functions (continued)

| PIN     |     | TYPE <sup>(1)</sup> | DESCRIPTION   |
|---------|-----|---------------------|---|
| NAME    | NO. |                     |   |
| Xin/CLK | 1   | I                   | Crystal oscillator input or LVCMOS clock Input (selectable through SDA/SCL bus) |
| Xout    | 16  | O                   | Crystal oscillator output (leave open or pull up when not used)                 |
| Y1      | 13  | O                   | LVCMOS output   |
| Y2      | 11  |                     |   |
| Y3      | 10  |                     |   |
| Y4      | 7   |                     |   |
| Y5      | 8   |                     |   |

## 7 Specifications

### 7.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

|   | MIN  | MAX            | UNIT |
|---|------|----------------|------|
| Supply voltage, $V_{DD}$                            | -0.5 | 2.5            | V    |
| Input voltage, $V_I$ <sup>(2)(3)</sup>              | -0.5 | $V_{DD} + 0.5$ | V    |
| Output voltage, $V_O$ <sup>(2)</sup>                | -0.5 | $V_{DD} + 0.5$ | V    |
| Input current, $I_I$ ( $V_I < 0$ , $V_I > V_{DD}$ ) |      | 20             | mA   |
| Continuous output current, $I_O$                    |      | 50             | mA   |
| Maximum junction temperature, $T_J$                 |      | 125            | °C   |
| Storage temperature, $T_{stg}$                      | -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 3.6 V 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 <sup>(1)</sup>              | ±2000 | V    |
|                                     | Charged-device model (CDM), per JEDEC specification JESD22-C101 <sup>(2)</sup> | ±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        | CDCE925  |                     | 3.6                 | V    |
|                   |                                 | CDCEL925                                       | 1.7                 | 1.9                 |      |
| $V_{IL}$          | Low-level input voltage LVCMOS  |  |                     | $0.3 \times V_{DD}$ | V    |
| $V_{IH}$          | High-level input voltage LVCMOS | $0.7 \times V_{DD}$                            |                     |                     | V    |
| $V_{I(thresh)}$   | Input voltage threshold LVCMOS  |  | $0.5 \times V_{DD}$ |                     | V    |
| $V_{I(S)}$        | Input voltage                   | S0   | 0                   | 1.9                 | V    |
|                   |                                 | S1, S2, SDA, SCL; $V_{I(thresh)} = 0.5 V_{DD}$ | 0                   | 3.6                 |      |
| $V_{I(CLK)}$      | Input voltage, CLK              | 0  |                     | 1.9                 | V    |
| $I_{OH} / I_{OL}$ | Output current                  | $V_{DDOUT} = 3.3$ V                            |                     | ±12                 | mA   |
|                   |                                 | $V_{DDOUT} = 2.5$ V                            |                     | ±10                 |      |
|                   |                                 | $V_{DDOUT} = 1.8$ V                            |                     | ±8                  |      |
| $C_L$             | Output load LVCMOS              |  |                     | 15                  | pF   |

## Recommended Operating Conditions (continued)

|                                       |   | MIN       | NOM       | MAX      | UNIT     |
|---------------------------------------|---|-----------|-----------|----------|----------|
| $T_A$                                 | Operating free-air temperature  | -40       |           | 85       | °C       |
| <b>CRYSTAL AND VCXO<sup>(1)</sup></b> |   |           |           |          |          |
| $f_{Xtal}$                            | Crystal input frequency (fundamental mode)                              | 8         | 27        | 32       | MHz      |
| ESR                                   | Effective series resistance   |           |           | 100      | $\Omega$ |
| $f_{PR}$                              | Pulling ( $0\text{ V} \leq V_{Ctrl} \leq 1.8\text{ V}$ ) <sup>(2)</sup> | $\pm 120$ | $\pm 150$ |          | 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 [VCXO Application Guideline for CDCE\(L\)9xx Family \(SCAA085\)](#).
- (2) Pulling range depends on crystal-type, on-chip crystal load capacitance and PCB stray capacitance; pulling range of minimum  $\pm 120$  ppm applies for crystal listed in [VCXO Application Guideline for CDCE\(L\)9xx Family \(SCAA085\)](#).

## 7.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |  | CDCEx925          | UNIT |      |
|-------------------------------|--|-------------------|------|------|
|                               |  | PW (TSSOP)        |      |      |
|                               |  | 20 PINS           |      |      |
| $R_{\theta JA}$               | Junction-to-ambient thermal resistance       | Airflow 0 (LFM)   | 101  | °C/W |
|                               |  | Airflow 150 (LFM) | 85   |      |
|                               |  | Airflow 200 (LFM) | 84   |      |
|                               |  | Airflow 250 (LFM) | 82   |      |
|                               |  | Airflow 500 (LFM) | 74   |      |
| $R_{\theta JC(top)}$          | Junction-to-case (top) thermal resistance    | 42                | °C/W |      |
| $R_{\theta JB}$               | Junction-to-board thermal resistance         | 63.63             | °C/W |      |
| $\Psi_{JT}$                   | Junction-to-top characterization parameter   | 1.01              | °C/W |      |
| $\Psi_{JB}$                   | Junction-to-board characterization parameter | 58.12             | °C/W |      |
| $R_{\theta JC(bot)}$          | Junction-to-case (bottom) thermal resistance | 58                | °C/W |      |

- (1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics](#) application report.

## 7.5 Electrical Characteristics

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

| PARAMETER      | TEST CONDITIONS   | MIN  | TYP <sup>(1)</sup>                      | MAX     | UNIT          |
|----------------|---|--|---|---------|---------------|
| $I_{DD}$       | Supply current (see <a href="#">Figure 1</a> )                              | All outputs off, $f_{CLK} = 27\text{ MHz}$ ,<br>$f_{VCO} = 135\text{ MHz}$ , $f_{OUT} = 27\text{ MHz}$ | All PLLS on                             | 20      | mA            |
|                |   |  | Per PLL                                 | 9       |               |
| $I_{DDOUT}$    | Supply current (see <a href="#">Figure 2</a> and <a href="#">Figure 3</a> ) | No load, all outputs on,<br>$f_{OUT} = 27\text{ MHz}$  | CDCE925,<br>$V_{DDOUT} = 3.3\text{ V}$  | 2       | mA            |
|                |   |  | CDCEL925,<br>$V_{DDOUT} = 1.8\text{ V}$ | 1       |               |
| $I_{DDPD}$     | Power-down current. Every circuit powered down except SDA/SCL               | $f_{IN} = 0\text{ MHz}$ , $V_{DD} = 1.9\text{ V}$  | 30                                      |         | $\mu\text{A}$ |
| $V_{PUC}$      | Supply voltage $V_{DD}$ threshold for power-up control circuit              |  | 0.85                                    | 1.45    | V             |
| $f_{VCO}$      | VCO frequency range of PLL  |  | 80                                      | 230     | MHz           |
| $f_{OUT}$      | LVC MOS output frequency  | CDCEx925 $V_{DDOUT} = 1.8\text{ V}$  | 230                                     |         | MHz           |
| <b>LVC MOS</b> |   |  |   |         |               |
| $V_{IK}$       | LVC MOS input voltage   | $V_{DD} = 1.7\text{ V}$ , $I_S = -18\text{ mA}$  |   | -1.2    | V             |
| $I_I$          | LVC MOS input current   | $V_I = 0\text{ V}$ or $V_{DD}$ , $V_{DD} = 1.9\text{ V}$   |   | $\pm 5$ | $\mu\text{A}$ |
| $I_{IH}$       | LVC MOS input current for S0/S1/S2  | $V_I = V_{DD}$ , $V_{DD} = 1.9\text{ V}$   |   | 5       | $\mu\text{A}$ |
| $I_{IL}$       | LVC MOS Input current for S0/S1/S2  | $V_I = 0\text{ V}$ , $V_{DD} = 1.9\text{ V}$   |   | -4      | $\mu\text{A}$ |

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

## Electrical Characteristics (continued)

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

| PARAMETER  |   | TEST CONDITIONS                                       | MIN | TYP <sup>(1)</sup> | MAX | UNIT |
|--|---|---|-----|--------------------|-----|------|
| C <sub>i</sub>   | Input capacitance at Xin/Clk              | V <sub>Clk</sub> = 0 V or V <sub>DD</sub>             |     | 6                  |     | pF   |
|  | Input capacitance at Xout                 | V <sub>Ixout</sub> = 0 V or V <sub>DD</sub>           |     | 2                  |     |      |
|  | Input capacitance at S0/S1/S2             | V <sub>IS</sub> = 0 V or V <sub>DD</sub>              |     | 3                  |     |      |
| <b>CDCE925 – LVCMOS FOR V<sub>DDOUT</sub> = 3.3 V</b>  |   |   |     |                    |     |      |
| V <sub>OH</sub>  | LVCMOS high-level output voltage          | V <sub>DDOUT</sub> = 3 V, I <sub>OH</sub> = –0.1 mA   | 2.9 |                    |     | V    |
|  |   | V <sub>DDOUT</sub> = 3 V, I <sub>OH</sub> = –8 mA     | 2.4 |                    |     |      |
|  |   | V <sub>DDOUT</sub> = 3 V, I <sub>OH</sub> = –12 mA    | 2.2 |                    |     |      |
| V <sub>OL</sub>  | LVCMOS low-level output voltage           | V <sub>DDOUT</sub> = 3 V, I <sub>OL</sub> = 0.1 mA    |     |                    | 0.1 | V    |
|  |   | V <sub>DDOUT</sub> = 3 V, I <sub>OL</sub> = 8 mA      |     |                    | 0.5 |      |
|  |   | V <sub>DDOUT</sub> = 3 V, I <sub>OL</sub> = 12 mA     |     |                    | 0.8 |      |
| t <sub>PLH</sub> , t <sub>PHL</sub>                    | Propagation delay                         | All PLL bypass  |     | 3.2                |     | ns   |
| t <sub>r</sub> /t <sub>f</sub>                         | Rise and fall time                        | V <sub>DDOUT</sub> = 3.3 V (20%–80%)                  |     | 0.6                |     | ns   |
| t <sub>jitter(cc)</sub>                                | Cycle-to-cycle jitter <sup>(2)(3)</sup>   | 1 PLL switching, Y2-to-Y3                             |     | 50                 | 70  | ps   |
|  |   | 2 PLL switching, Y2-to-Y5                             |     | 90                 | 130 |      |
| t <sub>jitter(per)</sub>                               | Peak-to-peak period jitter <sup>(3)</sup> | 1 PLL switching, Y2-to-Y3                             |     | 60                 | 100 | ps   |
|  |   | 2 PLL switching, Y2-to-Y5                             |     | 100                | 160 |      |
| t <sub>sk(o)</sub>                                     | Output skew <sup>(4)</sup>                | f <sub>OUT</sub> = 50 MHz, Y1-to-Y3                   |     |                    | 70  | ps   |
|  |   | f <sub>OUT</sub> = 50 MHz, Y2-to-Y5                   |     |                    | 150 |      |
| odc  | Output duty cycle <sup>(5)</sup>          | f <sub>VCO</sub> = 100 MHz, Pdiv = 1                  | 45% |                    | 55% |      |
| <b>CDCE925 – LVCMOS FOR V<sub>DDOUT</sub> = 2.5 V</b>  |   |   |     |                    |     |      |
| V <sub>OH</sub>  | LVCMOS high-level output voltage          | V <sub>DDOUT</sub> = 2.3 V, I <sub>OH</sub> = –0.1 mA | 2.2 |                    |     | V    |
|  |   | V <sub>DDOUT</sub> = 2.3 V, I <sub>OH</sub> = –6 mA   | 1.7 |                    |     |      |
|  |   | V <sub>DDOUT</sub> = 2.3 V, I <sub>OH</sub> = –10 mA  | 1.6 |                    |     |      |
| V <sub>OL</sub>  | LVCMOS low-level output voltage           | V <sub>DDOUT</sub> = 2.3 V, I <sub>OL</sub> = 0.1 mA  |     |                    | 0.1 | V    |
|  |   | V <sub>DDOUT</sub> = 2.3 V, I <sub>OL</sub> = 6 mA    |     |                    | 0.5 |      |
|  |   | V <sub>DDOUT</sub> = 2.3 V, I <sub>OL</sub> = 10 mA   |     |                    | 0.7 |      |
| t <sub>PLH</sub> , t <sub>PHL</sub>                    | Propagation delay                         | All PLL bypass  |     | 3.6                |     | ns   |
| t <sub>r</sub> /t <sub>f</sub>                         | Rise and fall time                        | V <sub>DDOUT</sub> = 2.5 V (20%–80%)                  |     | 0.8                |     | ns   |
| t <sub>jitter(cc)</sub>                                | Cycle-to-cycle jitter <sup>(2)(3)</sup>   | 1 PLL switching, Y2-to-Y3                             |     | 50                 | 70  | ps   |
|  |   | 2 PLL switching, Y2-to-Y5                             |     | 90                 | 130 |      |
| t <sub>jitter(per)</sub>                               | Peak-to-peak period jitter <sup>(3)</sup> | 1 PLL switching, Y2-to-Y3                             |     | 60                 | 100 | ps   |
|  |   | 2 PLL switching, Y2-to-Y5                             |     | 100                | 160 |      |
| t <sub>sk(o)</sub>                                     | Output skew <sup>(4)</sup>                | f <sub>OUT</sub> = 50 MHz, Y1-to-Y3                   |     |                    | 70  | ps   |
|  |   | f <sub>OUT</sub> = 50 MHz, Y2-to-Y5                   |     |                    | 150 |      |
| odc  | Output duty cycle <sup>(5)</sup>          | f <sub>VCO</sub> = 100 MHz, Pdiv = 1                  | 45% |                    | 55% |      |
| <b>CDCEL925 – LVCMOS FOR V<sub>DDOUT</sub> = 1.8 V</b> |   |   |     |                    |     |      |
| V <sub>OH</sub>  | LVCMOS high-level output voltage          | V <sub>DDOUT</sub> = 1.7 V, I <sub>OH</sub> = –0.1 mA | 1.6 |                    |     | V    |
|  |   | V <sub>DDOUT</sub> = 1.7 V, I <sub>OH</sub> = –4 mA   | 1.4 |                    |     |      |
|  |   | V <sub>DDOUT</sub> = 1.7 V, I <sub>OH</sub> = –8 mA   | 1.1 |                    |     |      |
| V <sub>OL</sub>  | LVCMOS low-level output voltage           | V <sub>DDOUT</sub> = 1.7 V, I <sub>OL</sub> = 0.1 mA  |     |                    | 0.1 | V    |
|  |   | V <sub>DDOUT</sub> = 1.7 V, I <sub>OL</sub> = 4 mA    |     |                    | 0.3 |      |
|  |   | V <sub>DDOUT</sub> = 1.7 V, I <sub>OL</sub> = 8 mA    |     |                    | 0.6 |      |
| t <sub>PLH</sub> , t <sub>PHL</sub>                    | Propagation delay                         | All PLL bypass  |     | 2.6                |     | ns   |
| t <sub>r</sub> /t <sub>f</sub>                         | Rise and fall time                        | V <sub>DDOUT</sub> = 1.8 V (20%–80%)                  |     | 0.7                |     | ns   |

(2) 10,000 cycles

(3) Jitter depends on configuration. Jitter data is for input frequency = 27 MHz, f<sub>VCO</sub> = 135 MHz, f<sub>OUT</sub> = 27 MHz. f<sub>OUT</sub> = 3.072 MHz or input frequency = 27 MHz, f<sub>VCO</sub> = 108 MHz, f<sub>OUT</sub> = 27 MHz. f<sub>OUT</sub> = 16.384 MHz, f<sub>OUT</sub> = 25 MHz, f<sub>OUT</sub> = 74.25 MHz, f<sub>OUT</sub> = 48 MHz

(4) The t<sub>sk(o)</sub> 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<sub>r</sub>).

(5) odc depends on output rise- and fall-time (t<sub>r</sub>/t<sub>f</sub>);

## Electrical Characteristics (continued)

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

| PARAMETER                |   | TEST CONDITIONS  | MIN                   | TYP <sup>(1)</sup> | MAX                   | UNIT |
|--------------------------|---|--|-----------------------|--------------------|-----------------------|------|
| t <sub>jitter(cc)</sub>  | Cycle-to-cycle jitter <sup>(2)</sup> <sup>(3)</sup> | 1 PLL switching, Y2-to-Y3                                  |                       | 80                 | 110                   | ps   |
|                          |   | 2 PLL switching, Y2-to-Y5                                  |                       | 130                | 200                   |      |
| t <sub>jitter(per)</sub> | Peak-to-peak period jitter <sup>(3)</sup>           | 1 PLL switching, Y2-to-Y3                                  |                       | 100                | 130                   | ps   |
|                          |   | 2 PLL switching, Y2-to-Y5                                  |                       | 150                | 220                   |      |
| t <sub>sk(o)</sub>       | Output skew <sup>(4)</sup>                          | f <sub>OUT</sub> = 50 MHz, Y1-to-Y3                        |                       |                    | 50                    | ps   |
|                          |   | f <sub>OUT</sub> = 50 MHz, Y2-to-Y5                        |                       |                    | 110                   |      |
| odc                      | Output duty cycle <sup>(5)</sup>                    | f <sub>VCO</sub> = 100 MHz, Pdiv = 1                       | 45%                   |                    | 55%                   |      |
| <b>SDA AND SCL</b>       |   |  |                       |                    |                       |      |
| V <sub>IK</sub>          | SCL and SDA input clamp voltage                     | V <sub>DD</sub> = 1.7 V, I <sub>I</sub> = -18 mA           |                       |                    | -1.2                  | V    |
| I <sub>IH</sub>          | SCL and SDA input current                           | V <sub>I</sub> = V <sub>DD</sub> , V <sub>DD</sub> = 1.9 V |                       |                    | ±10                   | µA   |
| V <sub>IH</sub>          | SDA/SCL input high voltage <sup>(6)</sup>           |  | 0.7 × V <sub>DD</sub> |                    |                       | V    |
| V <sub>IL</sub>          | SDA/SCL input low voltage <sup>(6)</sup>            |  |                       |                    | 0.3 × V <sub>DD</sub> | V    |
| V <sub>OL</sub>          | SDA low-level output voltage                        | I <sub>OL</sub> = 3 mA, V <sub>DD</sub> = 1.7 V            |                       |                    | 0.2 × V <sub>DD</sub> | V    |
| C <sub>I</sub>           | SCL/SDA input capacitance                           | V <sub>I</sub> = 0 V or V <sub>DD</sub>                    |                       | 3                  | 10                    | pF   |

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

## 7.6 EEPROM Specification

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

## 7.7 Timing Requirements: CLK\_IN

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

|                                 |  | MIN             | NOM | MAX | UNIT |
|---------------------------------|--|-----------------|-----|-----|------|
| f <sub>CLK</sub>                | LVCMOS clock input frequency               | PLL bypass mode | 0   | 160 | MHz  |
|                                 |  | PLL mode        | 8   | 160 |      |
| t <sub>r</sub> / t <sub>f</sub> | Rise and fall time CLK signal (20% to 80%) |                 |     | 3   | ns   |
| duty <sub>CLK</sub>             | Duty cycle CLK at V <sub>DD</sub> / 2      | 40%             |     | 60% |      |

## 7.8 Timing Requirements: SDA/SCL

 over operating free-air temperature range (unless otherwise noted; see [Figure 8](#))

|                        |  | MIN           | NOM | MAX  | UNIT |
|------------------------|--|---------------|-----|------|------|
| f <sub>SCL</sub>       | SCL clock frequency                        | Standard mode | 0   | 100  | kHz  |
|                        |  | Fast mode     | 0   | 400  |      |
| t <sub>su(START)</sub> | START setup time (SCL high before SDA low) | Standard mode | 4.7 |      | µs   |
|                        |  | Fast mode     | 0.6 |      |      |
| t <sub>h(START)</sub>  | START hold time (SCL low after SDA low)    | Standard mode | 4   |      | µs   |
|                        |  | Fast mode     | 0.6 |      |      |
| t <sub>w(SCLL)</sub>   | SCL low-pulse duration                     | Standard mode | 4.7 |      | µs   |
|                        |  | Fast mode     | 1.3 |      |      |
| t <sub>w(SCLH)</sub>   | SCL high-pulse duration                    | Standard mode | 4   |      | µs   |
|                        |  | Fast mode     | 0.6 |      |      |
| t <sub>h(SDA)</sub>    | SDA hold time (SDA valid after SCL low)    | Standard mode | 0   | 3.45 | µs   |
|                        |  | Fast mode     | 0   | 0.9  |      |
| t <sub>su(SDA)</sub>   | SDA setup time                             | Standard mode | 250 |      | ns   |
|                        |  | Fast mode     | 100 |      |      |



**Timing Requirements: SDA/SCL (continued)**

 over operating free-air temperature range (unless otherwise noted; see [Figure 8](#))

|                |  | MIN           | NOM | MAX | UNIT |         |
|----------------|--|---------------|-----|-----|------|---------|
| $t_r$          | SCL/SDA input rise time                          | Standard mode |     |     | 1000 | ns      |
|                |  | Fast mode     |     |     | 300  |         |
| $t_f$          | SCL/SDA input fall time, standard and fast mode  |               |     |     | 300  | ns      |
| $t_{su(STOP)}$ | STOP setup time                                  | Standard mode |     |     | 4    | $\mu$ s |
|                |  | Fast mode     |     |     | 0.6  |         |
| $t_{BUS}$      | Bus free time between a STOP and START condition | Standard mode |     |     | 4.7  | $\mu$ s |
|                |  | Fast mode     |     |     | 1.3  |         |

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7.9 Typical Characteristics

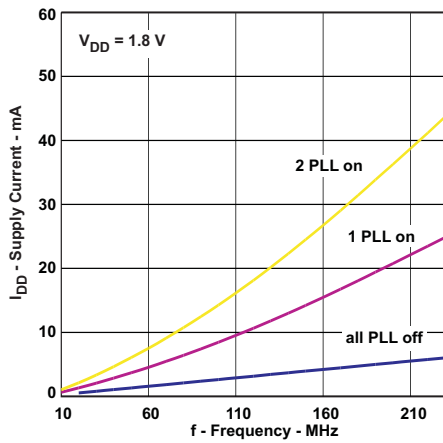


Figure 1. CDCE925 Supply Current vs PLL Frequency

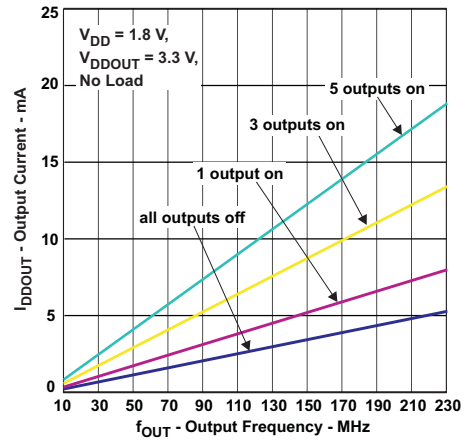


Figure 2. CDCE925 Output Current vs Output Frequency

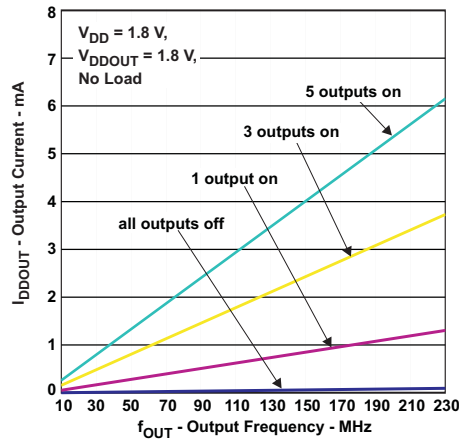
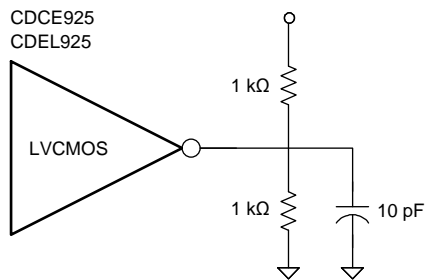


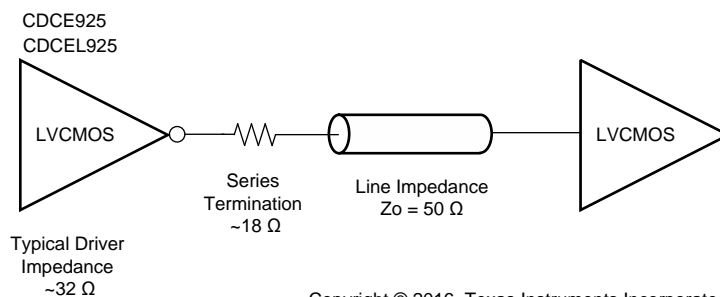
Figure 3. CDCEL925 Output Current vs Output Frequency

## 8 Parameter Measurement Information



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**Figure 4. Test Load**



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**Figure 5. Test Load for 50-Ω Board Environment**

## 9 Detailed Description

### 9.1 Overview

The CDCE925 and CDCEL925 devices are modular PLL-based, low-cost, high-performance, programmable clock synthesizers, multipliers, and dividers. They generate up to five output clocks from a single input frequency. Each output can be programmed in-system for any clock frequency up to 230 MHz, using one of the two integrated configurable PLLs.

The CDCx925 has separate output supply pins,  $V_{DDOUT}$ , which is 1.8 V for CDCEL925 and 2.5 V to 3.3 V for CDCE925.

The input accepts an external crystal or LVCMOS clock signal. If an external crystal is used, an on-chip load capacitor is adequate for most applications. The value of the load capacitor is programmable from 0 pF to 20 pF. Additionally, a selectable on-chip VCXO allows synchronization of the output frequency to an external control signal, that is, the PWM signal.

The deep M/N divider ratio allows the generation of 0-ppm audio and video, networking (WLAN, Bluetooth, Ethernet, GPS), or interface (USB, IEEE1394, memory stick) clocks from a reference input frequency such as 27 MHz.

All PLLs support spread-spectrum clocking (SSC). SSC can be center-spread or down-spread clocking. This is a common technique to reduce electro-magnetic interference (EMI).

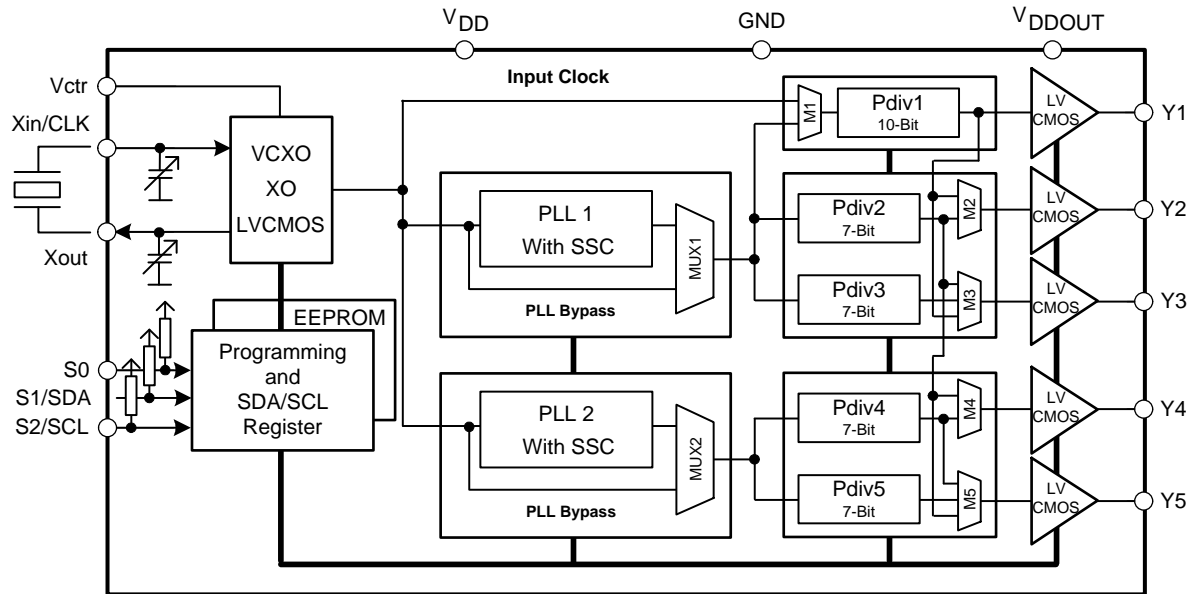
Based on the PLL frequency and the divider settings, the internal loop filter components are automatically adjusted to achieve high stability, and to optimize the jitter-transfer characteristic of each PLL.

The device supports non-volatile EEPROM programming for easy customization of the device in the application. It is preset to a factory default configuration (see [Default Device Setting](#)). It can be reprogrammed to a different application configuration before PCB assembly, or reprogrammed by in-system programming. All device settings are programmable through the SDA and SCL bus, a 2-wire serial interface.

Three free programmable control inputs, S0, S1, and S2, can be used to control various aspects of operation including frequency selection, changing the SSC parameters to lower EMI, PLL bypass, power down, or other control features like outputs disable to low, outputs in high-impedance state, and so forth.

The CDCx925 operates in a 1.8-V environment. It operates within a temperature range of  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

## 9.2 Functional Block Diagram



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Figure 6. Functional Block Diagram for CDCE925

## 9.3 Feature Description

### 9.3.1 Control Terminal Setting

The CDCE925 has three user-definable control terminals (S0, S1, and S2) which allow external control of device settings. They can be programmed to any of the following settings:

- Spread spectrum clocking selection → spread type and spread amount selection
- 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 Terminal Definition

| EXTERNAL CONTROL BITS | PLL1 SETTING            |               |                        | PLL2 SETTING            |               |                        | Y1 SETTING                         |
|-----------------------|-------------------------|---------------|------------------------|-------------------------|---------------|------------------------|------------------------------------|
|                       | PLL frequency selection | SSC selection | Output Y2/Y3 selection | PLL frequency selection | SSC selection | Output Y4/Y5 selection | Output Y1 and power-down selection |
| Control function      |                         |               |                        |                         |               |                        |                                    |

Table 2. PLL Setting (Can Be Selected for Each PLL Individual)<sup>(1)</sup>

| SSC SELECTION (CENTER/DOWN) |   |   |          |          |
|-----------------------------|---|---|----------|----------|
| SSCx [3-Bits]               |   |   | CENTER   | DOWN     |
| 0                           | 0 | 0 | 0% (off) | 0% (off) |
| 0                           | 0 | 1 | ±0.25%   | –0.25%   |
| 0                           | 1 | 0 | ±0.5%    | –0.5%    |
| 0                           | 1 | 1 | ±0.75%   | –0.75%   |
| 1                           | 0 | 0 | ±1%      | –1.0%    |
| 1                           | 0 | 1 | ±1.25%   | –1.25%   |

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

**Table 2. PLL Setting (Can Be Selected for Each PLL Individual)<sup>0</sup> (continued)**

| SSC SELECTION (CENTER/DOWN)                 |   |            |        |       |
|---|---|------------|--------|-------|
| SSCx [3-Bits]                               |   |            | CENTER | DOWN  |
| 1   | 1 | 0          | ±1.5%  | –1.5% |
| 1   | 1 | 1          | ±2%    | –2%   |
| FREQUENCY SELECTION <sup>(2)</sup>          |   |            |        |       |
| FSx   |   | FUNCTION   |        |       |
| 0   |   | Frequency0 |        |       |
| 1   |   | Frequency1 |        |       |
| OUTPUT SELECTION <sup>(3)</sup> (Y2 ... Y5) |   |            |        |       |
| YxYx  |   | FUNCTION   |        |       |
| 0   |   | State0     |        |       |
| 1   |   | State1     |        |       |

(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

**Table 3. Y1 Setting<sup>(1)</sup>**

| Y1 SELECTION |          |
|--------------|----------|
| Y1           | FUNCTION |
| 0            | State 0  |
| 1            | State 1  |

(1) State0 and State1 are user definable in the generic configuration register and can be power down, high-impedance state, low, or active.

SDA/S1 and SCL/S2 pins of the CDCE925 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, temporarily act as serial programming pins (SDA/SCL).

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

### 9.3.2 Default Device Setting

The internal EEPROM of CDCE925 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 through the serial SDA/SCL interface.

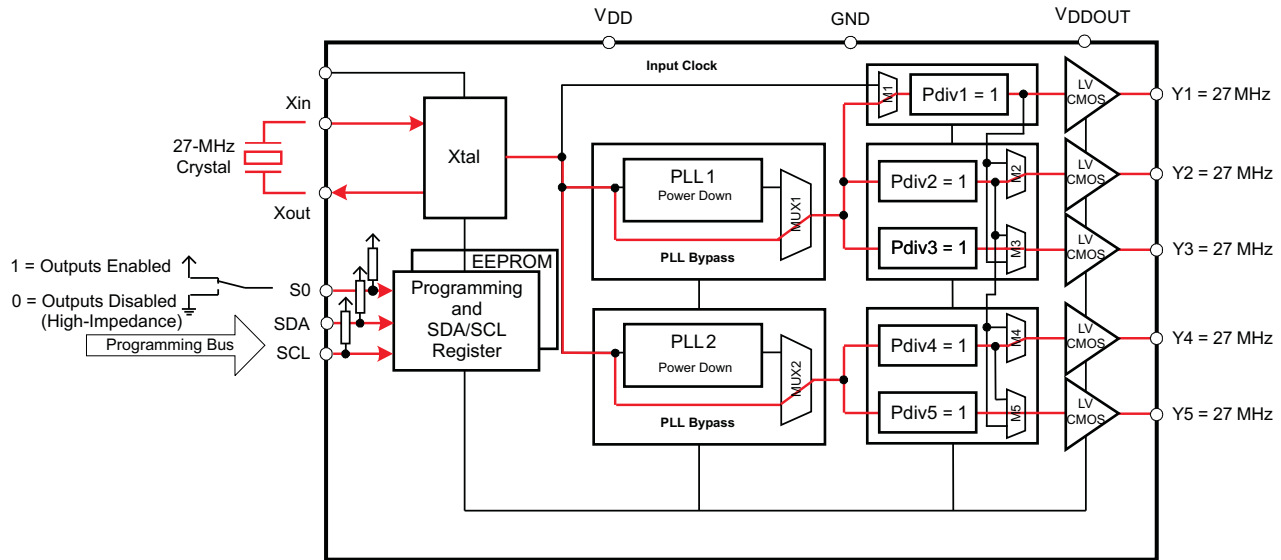


Figure 7. Preconfiguration of CDCE925 Internal EEPROM

Table 4 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 4. Factory Default Settings for Control Terminal Register<sup>(1)</sup>

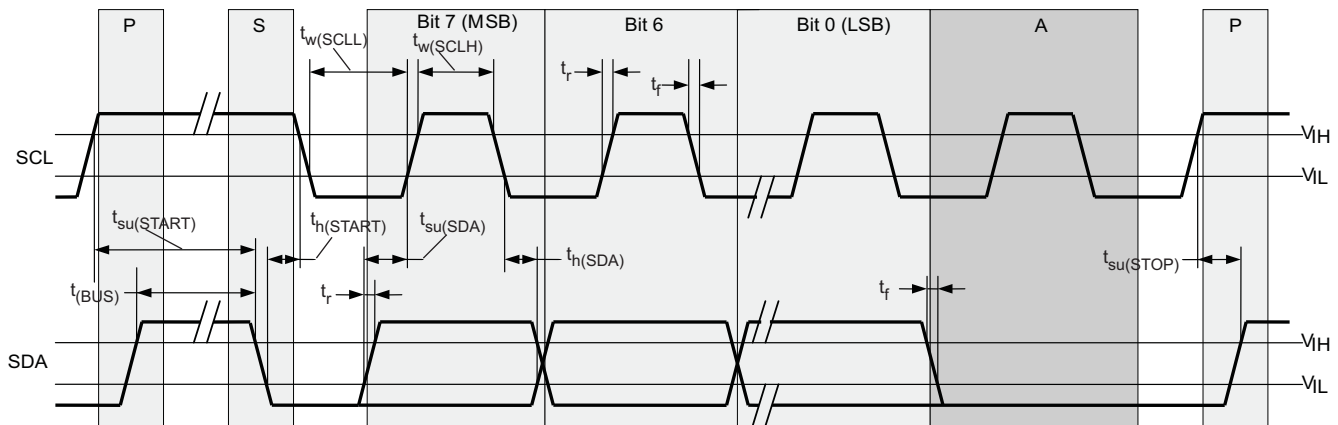
|                       |                        |    | Y1                   | PLL1 SETTINGS       |               |                      | PLL2 SETTINGS       |               |                      |
|-----------------------|------------------------|----|----------------------|---------------------|---------------|----------------------|---------------------|---------------|----------------------|
| EXTERNAL CONTROL PINS |                        |    | OUTPUT SELECTION     | FREQUENCY SELECTION | SSC SELECTION | OUTPUT SELECTION     | FREQUENCY SELECTION | SSC SELECTION | OUTPUT SELECTION     |
| S2                    | S1                     | S0 | Y1                   | FS1                 | SSC1          | Y2Y3                 | FS2                 | SSC2          | Y4Y5                 |
| SCL (I2C)             | SDA (I <sup>2</sup> C) | 0  | High-impedance state | f <sub>VC01_0</sub> | Off           | High-impedance state | f <sub>VC02_0</sub> | Off           | High-impedance state |
| SCL (I2C)             | SDA (I <sup>2</sup> C) | 1  | Enabled              | f <sub>VC01_0</sub> | Off           | Enabled              | f <sub>VC02_0</sub> | Off           | 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).

### 9.3.3 SDA/SCL Serial Interface

This section describes the SDA/SCL interface of the CDCE925 device. The CDCE925 operates as a slave device of the 2-wire serial SDA/SCL bus, compatible with the popular SMBus or I<sup>2</sup>C specification. It operates in the standard-mode transfer (up to 100 kbps) and fast-mode transfer (up to 400 kbps) and supports 7-bit addressing.

The SDA/S1 and SCL/S2 pins of the CDCE925 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 8. Timing Diagram for SDA/SCL Serial Control Interface**

### 9.3.4 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 5](#).

**Table 5. Slave Receiver Address (7 Bits)**

| DEVICE   | A6 | A5 | A4 | A3 | A2 | A1 <sup>(1)</sup> | A0 <sup>(1)</sup> | R/W |
|----------|----|----|----|----|----|-------------------|-------------------|-----|
| CDCEx913 | 1  | 1  | 0  | 0  | 1  | 0                 | 1                 | 1/0 |
| CDCEx925 | 1  | 1  | 0  | 0  | 1  | 0                 | 0                 | 1/0 |
| CDCEx925 | 1  | 1  | 0  | 1  | 1  | 0                 | 1                 | 1/0 |
| CDCEx949 | 1  | 1  | 0  | 1  | 1  | 0                 | 0                 | 1/0 |

(1) Address bits A0 and A1 are programmable through 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.

## 9.4 Device Functional Modes

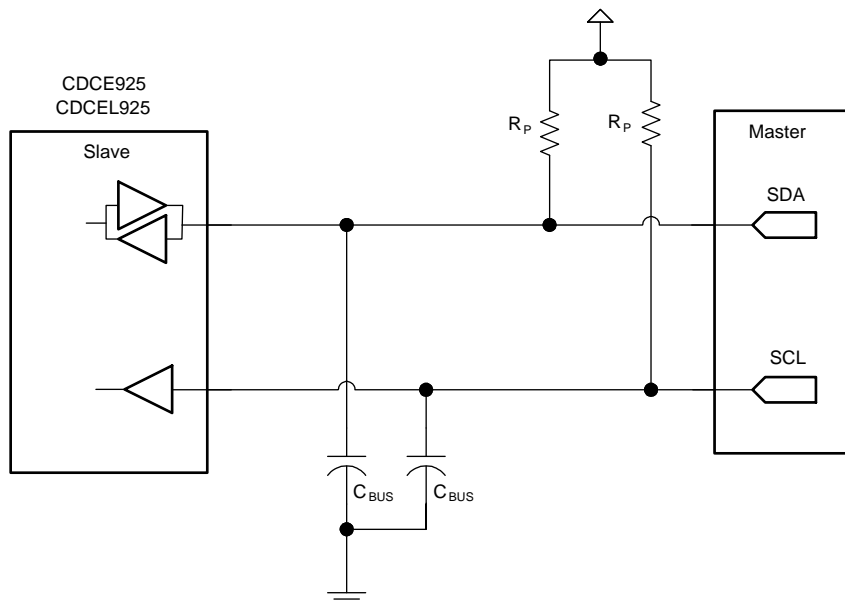
### 9.4.1 SDA/SCL Hardware Interface

[Figure 9](#) shows how the CDCEx925 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 $\Omega$ . It must meet the minimum sink current of 3 mA at  $V_{OLmax} = 0.4$  V for the output stages (for more details, see [SMBus](#) or [I<sup>2</sup>C Bus](#) specification).



Device Functional Modes (continued)



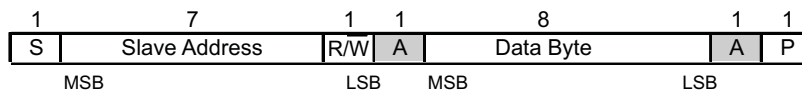
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Figure 9. SDA/SCL Hardware Interface

9.5 Programming

Table 6. Command Code Definition

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

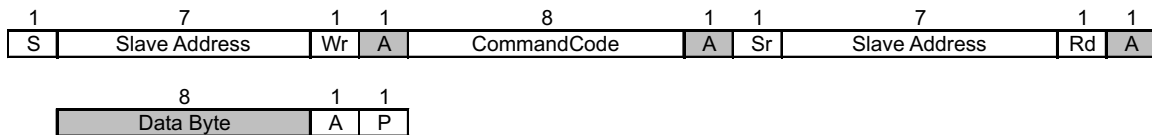
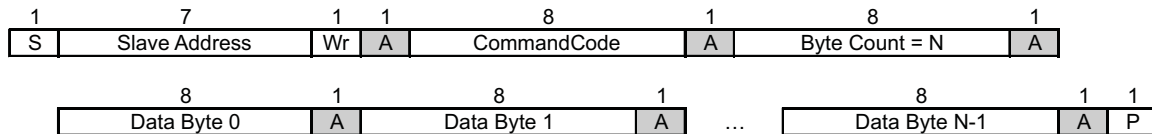


- S** Start Condition
- Sr** Repeated Start Condition
- R/W** 1 = Read (Rd) From CDCE9xx Device; 0 = Write (Wr) to CDCE9xxx
- A** Acknowledge (ACK = 0 and NACK =1)
- P** Stop Condition
- Master-to-Slave Transmission
- Slave-to-Master Transmission

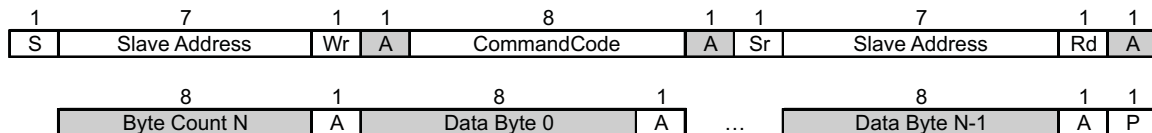
Figure 10. Generic Programming Sequence



Figure 11. Byte Write Protocol


**Figure 12. Byte Read Protocol**


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

**Figure 13. Block Write Protocol**

**Figure 14. 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 CDCE925. All settings can be manually written into the device through the SDA/SCL bus or easily programmed by using the TI Pro-Clock™ software. TI Pro-Clock software allows the user to quickly make all settings and automatically calculates the values for optimized performance at lowest jitter.

**Table 7. SDA/SCL Registers**

| ADDRESS OFFSET | REGISTER DESCRIPTION           | TABLE                    |
|----------------|--------------------------------|--------------------------|
| 00h            | Generic configuration register | <a href="#">Table 9</a>  |
| 10h            | PLL1 configuration register    | <a href="#">Table 10</a> |
| 20h            | PLL2 configuration register    | <a href="#">Table 11</a> |

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 (see [Control Terminal Setting](#)).

**Table 8. Configuration Register, External Control Terminals**

|   | EXTERNAL CONTROL PINS         |    |    | Y1               | PLL1 SETTINGS       |               |                  | PLL2 SETTINGS       |               |                  |
|---|-------------------------------|----|----|------------------|---------------------|---------------|------------------|---------------------|---------------|------------------|
|   | S2                            | S1 | S0 | OUTPUT SELECTION | FREQUENCY SELECTION | SSC SELECTION | OUTPUT SELECTION | FREQUENCY SELECTION | SSC SELECTION | OUTPUT SELECTION |
|   |                               |    |    | Y1               | FS1                 | SSC1          | Y2Y3             | FS2                 | SSC2          | Y4Y5             |
| 0 | 0                             | 0  | 0  | Y1_0             | FS1_0               | SSC1_0        | Y2Y3_0           | FS2_0               | SSC2_0        | Y4Y5_0           |
| 1 | 0                             | 0  | 1  | Y1_1             | FS1_1               | SSC1_1        | Y2Y3_1           | FS2_1               | SSC2_1        | Y4Y5_1           |
| 2 | 0                             | 1  | 0  | Y1_2             | FS1_2               | SSC1_2        | Y2Y3_2           | FS2_2               | SSC2_2        | Y4Y5_2           |
| 3 | 0                             | 1  | 1  | Y1_3             | FS1_3               | SSC1_3        | Y2Y3_3           | FS2_3               | SSC2_3        | Y4Y5_3           |
| 4 | 1                             | 0  | 0  | Y1_4             | FS1_4               | SSC1_4        | Y2Y3_4           | FS2_4               | SSC2_4        | Y4Y5_4           |
| 5 | 1                             | 0  | 1  | Y1_5             | FS1_5               | SSC1_5        | Y2Y3_5           | FS2_5               | SSC2_5        | Y4Y5_5           |
| 6 | 1                             | 1  | 0  | Y1_6             | FS1_6               | SSC1_6        | Y2Y3_6           | FS2_6               | SSC2_6        | Y4Y5_6           |
| 7 | 1                             | 1  | 1  | Y1_7             | FS1_7               | SSC1_7        | Y2Y3_7           | FS2_7               | SSC2_7        | Y4Y5_7           |
|   | Address offset <sup>(1)</sup> |    |    | 04h              | 13h                 | 10h–12h       | 15h              | 23h                 | 20h–22h       | 25h              |

(1) Address offset refers to the byte address in the configuration register in [Table 9](#), [Table 10](#), and [Table 11](#).

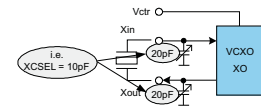
**Table 9. Generic Configuration Register**

| OFFSET <sup>(1)</sup> | BIT <sup>(2)</sup> | ACRONYM | DEFAULT <sup>(3)</sup>                               | DESCRIPTION  |
|-----------------------|--------------------|---------|--|--|
| 00h                   | 7                  | E_EL    | Xb   | Device identification (read-only): 1 is CDCE925 (3.3 V out), 0 is CDCEL925 (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 Status <sup>(4)</sup> : (read-only)<br>0 – EEPROM programming is completed<br>1 – EEPROM is in programming mode   |
|                       | 5                  | EELOCK  | 0b   | Permanently lock EEPROM data <sup>(5)</sup><br>0 – EEPROM is not locked<br>1 – EEPROM is permanently locked  |
|                       | 4                  | PWDN    | 0b   | Device power down (overwrites S0/S1/S2 setting; configuration register settings are unchanged)<br>Note: PWDN cannot be set to 1 in the EEPROM.<br>0 – Device active (all PLLs and all outputs are enabled)<br>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 |  |

- (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 through 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 through 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.

**Table 9. Generic Configuration Register (continued)**

| OFFSET <sup>(1)</sup> | BIT <sup>(2)</sup> | ACRONYM     | DEFAULT <sup>(3)</sup> | DESCRIPTION  |
|-----------------------|--------------------|-------------|------------------------|--|
| 02h                   | 7                  | M1          | 1b                     | Clock source selection for output Y1: 0 – Input clock 1 – PLL1 clock   |
|                       | 6                  | SPICON      | 0b                     | Operation mode selection for pins 14/15 <sup>(6)</sup><br>0 – Serial programming interface SDA (pin 15) and SCL (pin 14)<br>1 – Control pins S1 (pin 15) and S2 (pin 14)                                 |
|                       | 5:4                | Y1_ST1      | 11b                    | Y1-State0/1 definition<br>00 – Device power down (all PLLs in power down and all outputs in high-impedance state)<br>01 – Y1 disabled to high-impedance state 10 – Y1 disabled to low<br>11 – Y1 enabled |
|                       | 3:2                | Y1_ST0      | 01b                    |  |
|                       | 1:0                | Pdiv1 [9:8] | 001h                   |  |
| 03h                   | 7:0                | Pdiv1 [7:0] |                        | 10-bit Y1-Output-Divider Pdiv1: 0 – Divider is reset and in standby 1 to 1023 – Divider value  |
| 04h                   | 7                  | Y1_7        | 0b                     | Y1_ST0/Y1_ST1 State Selection <sup>(7)</sup><br>0 – State0 (predefined by Y1_ST0)<br>1 – State1 (predefined by Y1_ST1)   |
|                       | 6                  | Y1_6        | 0b                     |  |
|                       | 5                  | Y1_6        | 0b                     |  |
|                       | 4                  | Y1_6        | 0b                     |  |
|                       | 3                  | Y1_6        | 0b                     |  |
|                       | 2                  | Y1_6        | 0b                     |  |
|                       | 1                  | Y1_6        | 0b                     |  |
|                       | 0                  | Y1_6        | 0b                     |  |
| 05h                   | 7:3                | XCSEL       | 0Ah                    | Crystal load-capacitor selection <sup>(8)</sup><br>00h – 0 pF<br>01h – 1 pF<br>02h – 2 pF<br>:<br>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 is 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 <sup>(9)</sup> 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   |



**Table 10. PLL1 Configuration Register**

| OFFSET <sup>(1)</sup> | BIT <sup>(2)</sup> | ACRONYM       | DEFAULT <sup>(3)</sup> | DESCRIPTION  |             |               |           |           |             |             |            |            |             |             |            |            |             |             |            |            |            |            |
|-----------------------|--------------------|---------------|------------------------|--|-------------|---------------|-----------|-----------|-------------|-------------|------------|------------|-------------|-------------|------------|------------|-------------|-------------|------------|------------|------------|------------|
| 10h                   | 7:5                | SSC1_7 [2:0]  | 000b                   | SSC1: PLL1 SSC selection (modulation amount). <sup>(4)</sup><br><br><table border="0"> <tr> <td><b>Down</b></td> <td><b>Center</b></td> </tr> <tr> <td>000 (Off)</td> <td>000 (Off)</td> </tr> <tr> <td>001 – 0.25%</td> <td>001 ± 0.25%</td> </tr> <tr> <td>010 – 0.5%</td> <td>010 ± 0.5%</td> </tr> <tr> <td>011 – 0.75%</td> <td>011 ± 0.75%</td> </tr> <tr> <td>100 – 1.0%</td> <td>100 ± 1.0%</td> </tr> <tr> <td>101 – 1.25%</td> <td>101 ± 1.25%</td> </tr> <tr> <td>110 – 1.5%</td> <td>110 ± 1.5%</td> </tr> <tr> <td>111 – 2.0%</td> <td>111 ± 2.0%</td> </tr> </table> | <b>Down</b> | <b>Center</b> | 000 (Off) | 000 (Off) | 001 – 0.25% | 001 ± 0.25% | 010 – 0.5% | 010 ± 0.5% | 011 – 0.75% | 011 ± 0.75% | 100 – 1.0% | 100 ± 1.0% | 101 – 1.25% | 101 ± 1.25% | 110 – 1.5% | 110 ± 1.5% | 111 – 2.0% | 111 ± 2.0% |
|                       | <b>Down</b>        | <b>Center</b> |                        |  |             |               |           |           |             |             |            |            |             |             |            |            |             |             |            |            |            |            |
|                       | 000 (Off)          | 000 (Off)     |                        |  |             |               |           |           |             |             |            |            |             |             |            |            |             |             |            |            |            |            |
| 001 – 0.25%           | 001 ± 0.25%        |               |                        |  |             |               |           |           |             |             |            |            |             |             |            |            |             |             |            |            |            |            |
| 010 – 0.5%            | 010 ± 0.5%         |               |                        |  |             |               |           |           |             |             |            |            |             |             |            |            |             |             |            |            |            |            |
| 011 – 0.75%           | 011 ± 0.75%        |               |                        |  |             |               |           |           |             |             |            |            |             |             |            |            |             |             |            |            |            |            |
| 100 – 1.0%            | 100 ± 1.0%         |               |                        |  |             |               |           |           |             |             |            |            |             |             |            |            |             |             |            |            |            |            |
| 101 – 1.25%           | 101 ± 1.25%        |               |                        |  |             |               |           |           |             |             |            |            |             |             |            |            |             |             |            |            |            |            |
| 110 – 1.5%            | 110 ± 1.5%         |               |                        |  |             |               |           |           |             |             |            |            |             |             |            |            |             |             |            |            |            |            |
| 111 – 2.0%            | 111 ± 2.0%         |               |                        |  |             |               |           |           |             |             |            |            |             |             |            |            |             |             |            |            |            |            |
| 4:2                   | SSC1_6 [2:0]       | 000b          |                        |  |             |               |           |           |             |             |            |            |             |             |            |            |             |             |            |            |            |            |
| 1:0                   | SSC1_5 [2:1]       | 000b          |                        |  |             |               |           |           |             |             |            |            |             |             |            |            |             |             |            |            |            |            |
| 11h                   | 7                  |               | SSC1_5 [0]             |  |             |               |           |           |             |             |            |            |             |             |            |            |             |             |            |            |            |            |
| 11h                   | 6:4                | SSC1_4 [2:0]  | 000b                   |  |             |               |           |           |             |             |            |            |             |             |            |            |             |             |            |            |            |            |
|                       | 3:1                | SSC1_3 [2:0]  | 000b                   |  |             |               |           |           |             |             |            |            |             |             |            |            |             |             |            |            |            |            |
|                       | 0                  | SSC1_2 [2]    | 000b                   |  |             |               |           |           |             |             |            |            |             |             |            |            |             |             |            |            |            |            |
| 12h                   | 7:6                | SSC1_2 [1:0]  |                        |  |             |               |           |           |             |             |            |            |             |             |            |            |             |             |            |            |            |            |
| 12h                   | 5:3                | SSC1_1 [2:0]  | 000b                   |  |             |               |           |           |             |             |            |            |             |             |            |            |             |             |            |            |            |            |
|                       | 2:0                | SSC1_0 [2:0]  | 000b                   |  |             |               |           |           |             |             |            |            |             |             |            |            |             |             |            |            |            |            |

- (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<sub>DDOUT</sub> is forced to GND, the two control pins, S1 and S2, temporarily act as serial programming pins (SDA/SCL), and the two slave receiver address bits are reset to A0 = 0 and A1 = 0.
- (7) These are the bits of 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.
- (8) The internal load capacitor (C1, C2) must be used to achieve the best clock performance. External capacitors must be used only to finely adjust C<sub>L</sub> by a few picofarads. The value of C<sub>L</sub> can be programmed with a resolution of 1 pF for a crystal load range of 0 pF to 20 pF. For CL > 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<sub>L</sub>. For more information about VCXO configuration and crystal recommendation, see [VCXO Application Guideline for CDCE\(L\)9xx Family \(SCAA085\)](#).
- (9) 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.
- (1) Writing data beyond 30h may adversely affect device function.
- (2) All data is transferred MSB-first.
- (3) Unless a custom setting is used
- (4) The user can predefine up to eight different control settings. In normal device operation, these settings can be selected by the external control pins, S0, S1, and S2.

**Table 10. PLL1 Configuration Register (continued)**

| OFFSET <sup>(1)</sup> | BIT <sup>(2)</sup> | ACRONYM        | DEFAULT <sup>(3)</sup> | DESCRIPTION   |
|-----------------------|--------------------|----------------|------------------------|---|
| 13h                   | 7                  | FS1_7          | 0b                     | FS1_x: PLL1 frequency selection <sup>(4)</sup><br>0 – $f_{VCO1_0}$ (predefined by PLL1_0 – multiplier/divider value)<br>1 – $f_{VCO1_1}$ (predefined by PLL1_1 – multiplier/divider value)  |
|                       | 6                  | FS1_6          | 0b                     |   |
|                       | 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<br>1 – PLL1 bypass (PLL1 is in power down)   |
|                       | 6                  | M2             | 1b                     | Output Y2 multiplexer: 0 – Pdiv1<br>1 – Pdiv2   |
|                       | 5:4                | M3             | 10b                    | Output Y3 multiplexer: 00 – Pdiv1-divider<br>01 – Pdiv2-divider<br>10 – Pdiv3-divider<br>11 – Reserved  |
|                       | 3:2                | Y2Y3_ST1       | 11b                    | Y2, Y3-state0/1definition: 00 – Y2/Y3 disabled to high-impedance state (PLL1 is in power down)<br>01 – Y2/Y3 disabled to high-impedance state (PLL1 on)<br>10 – Y2/Y3 disabled to low (PLL1 on)<br>11 – Y2/Y3 enabled (normal operation, PLL1 on) |
|                       | 1:0                | Y2Y3_ST0       | 01b                    |   |
| 15h                   | 7                  | Y2Y3_7         | 0b                     | Y2Y3_x output state selection <sup>(4)</sup><br>0 – state0 (predefined by Y2Y3_ST0)<br>1 – state1 (predefined by Y2Y3_ST1)  |
|                       | 6                  | Y2Y3_6         | 0b                     |   |
|                       | 5                  | Y2Y3_5         | 0b                     |   |
|                       | 4                  | Y2Y3_4         | 0b                     |   |
|                       | 3                  | Y2Y3_3         | 0b                     |   |
|                       | 2                  | Y2Y3_2         | 0b                     |   |
|                       | 1                  | Y2Y3_1         | 1b                     |   |
|                       | 0                  | Y2Y3_0         | 0b                     |   |
| 16h                   | 7                  | SSC1DC         | 0b                     | PLL1 SSC down/center selection: 0 – Down<br>1 – Center  |
|                       | 6:0                | Pdiv2          | 01h                    | 7-bit Y2-output-divider Pdiv2: 0 – Reset and in standby<br>1 to 127 – Divider value   |
| 17h                   | 7                  | —              | 0b                     | Reserved – do not write others than 0   |
|                       | 6:0                | Pdiv3          | 01h                    | 7-bit Y3-output-divider Pdiv3: 0 – Reset and in standby<br>1 to 127 – Divider value   |
| 18h                   | 7:0                | PLL1_ON [11:4] | 004h                   | PLL1_0 <sup>(5)</sup> : 30-bit multiplier/divider value for frequency $f_{VCO1_0}$ (for more information, see <a href="#">PLL Multiplier/Divider Definition</a> ).  |
| 19h                   | 7:4                | PLL1_ON [3:0]  |                        |   |
|                       | 3:0                | PLL1_OR [8:5]  |                        |   |
| 1Ah                   | 7:3                | PLL1_OR[4:0]   |                        |   |
|                       | 2:0                | PLL1_OQ [5:3]  |                        |   |
| 1Bh                   | 7:5                | PLL1_OQ [2:0]  | 010b                   | $f_{VCO1_0}$ range selection: 00 – $f_{VCO1_0} < 125$ MHz<br>01 – $125 \text{ MHz} \leq f_{VCO1_0} < 150$ MHz<br>10 – $150 \text{ MHz} \leq f_{VCO1_0} < 175$ MHz<br>11 – $f_{VCO1_0} \geq 175$ MHz   |
|                       | 4:2                | PLL1_OP [2:0]  |                        |   |
|                       | 1:0                | VCO1_0_RANGE   | 00b                    |   |

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

**Table 10. PLL1 Configuration Register (continued)**

| OFFSET <sup>(1)</sup> | BIT <sup>(2)</sup> | ACRONYM        | DEFAULT <sup>(3)</sup> | DESCRIPTION   |
|-----------------------|--------------------|----------------|------------------------|---|
| 1Ch                   | 7:0                | PLL1_1N [11:4] | 004h                   | PLL1_1 <sup>(5)</sup> : 30-bit multiplier/divider value for frequency $f_{VCO1\_1}$ (for more information, see <a href="#">PLL Multiplier/Divider Definition</a> ). |
| 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   |

**Table 11. PLL2 Configuration Register**

| OFFSET <sup>(1)</sup> | BIT <sup>(2)</sup> | ACRONYM      | DEFAULT <sup>(3)</sup> | DESCRIPTION  |  |
|-----------------------|--------------------|--------------|------------------------|--|--|
| 20h                   | 7:5                | SSC2_7 [2:0] | 000b                   | SSC2: PLL2 SSC selection (modulation amount). <sup>(4)</sup><br><br><b>Down</b><br>000 (Off)<br>001 – 0.25%<br>010 – 0.5%<br>011 – 0.75%<br>100 – 1.0%<br>101 – 1.25%<br>110 – 1.5%<br>111 – 2.0%<br><br><b>Center</b><br>000 (Off)<br>001 ± 0.25%<br>010 ± 0.5%<br>011 ± 0.75%<br>100 ± 1.0%<br>101 ± 1.25%<br>110 ± 1.5%<br>111 ± 2.0% |  |
|                       | 4:2                | SSC2_6 [2:0] | 000b                   |  |  |
|                       | 1:0                | SSC2_5 [2:1] | 000b                   |  |  |
| 21h                   | 7                  | SSC2_5 [0]   |                        |  |  |
|                       | 6:4                | SSC2_4 [2:0] | 000b                   |  |  |
|                       | 3:1                | SSC2_3 [2:0] | 000b                   |  |  |
| 22h                   | 0                  | SSC2_2 [2]   | 000b                   |  |  |
|                       | 7:6                | SSC2_2 [1:0] |                        |  |  |
|                       | 5:3                | SSC2_1 [2:0] | 000b                   |  |  |
| 23h                   | 2:0                | SSC2_0 [2:0] | 000b                   |  |  |
|                       | 7                  | FS2_7        | 0b                     |  | FS2_x: PLL2 frequency selection <sup>(4)</sup><br><br>0 – $f_{VCO2\_0}$ (predefined by PLL2_0 – multiplier/divider value)<br>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:<br>0 – PLL2<br>1 – PLL2 bypass (PLL2 is in power down)   |  |
|                       | 6                  | M4           | 1b                     | Output Y4 multiplexer:<br>0 – Pdiv2<br>1 – Pdiv4   |  |
|                       | 5:4                | M5           | 10b                    | Output Y5 multiplexer:<br>00 – Pdiv2-divider<br>01 – Pdiv4-divider<br>10 – Pdiv5-divider<br>11 – Reserved  |  |
|                       | 3:2                | Y4Y5_ST1     | 11b                    | Y4, Y5-State0/1definition:<br>00 – Y4/Y5 disabled to high-impedance state (PLL2 is in power down)<br>01 – Y4/Y5 disabled to high-impedance state (PLL2 on)<br>10 – Y4/Y5 disabled to low (PLL2 on)<br>11 – Y4/Y5 enabled (normal operation, PLL2 on)   |  |
|                       | 1:0                | Y4Y5_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

(4) The user can predefine up to eight different control settings. In normal device operation, these settings can be selected by the external control pins, S0, S1, and S2.

**Table 11. PLL2 Configuration Register (continued)**

| OFFSET <sup>(1)</sup> | BIT <sup>(2)</sup> | ACRONYM        | DEFAULT <sup>(3)</sup> | DESCRIPTION  |
|-----------------------|--------------------|----------------|------------------------|--|
| 25h                   | 7                  | Y4Y5_7         | 0b                     | Y4Y5_x output state selection <sup>(4)</sup><br>0 – state0 (predefined by Y4Y5_ST0)<br>1 – state1 (predefined by Y4Y5_ST1)   |
|                       | 6                  | Y4Y5_6         | 0b                     |  |
|                       | 5                  | Y4Y5_5         | 0b                     |  |
|                       | 4                  | Y4Y5_4         | 0b                     |  |
|                       | 3                  | Y4Y5_3         | 0b                     |  |
|                       | 2                  | Y4Y5_2         | 0b                     |  |
|                       | 1                  | Y4Y5_1         | 1b                     |  |
|                       | 0                  | Y4Y5_0         | 0b                     |  |
| 26h                   | 7                  | SSC2DC         | 0b                     | PLL2 SSC down/center selection: 0 – Down<br>1 – Center   |
|                       | 6:0                | Pdiv4          | 01h                    | 7-Bit Y4-output-divider Pdiv4: 0 – Reset and in standby<br>1 to 127 – Divider value  |
| 27h                   | 7                  | —              | 0b                     | Reserved – do not write others than 0  |
|                       | 6:0                | Pdiv5          | 01h                    | 7-bit Y5-output-divider Pdiv5: 0 – Reset and in standby<br>1 to 127 – Divider value  |
| 28h                   | 7:0                | PLL2_0N [11:4] | 004h                   | PLL2_0 <sup>(5)</sup> : 30-Bit Multiplier/Divider value for frequency $f_{VCO2\_0}$<br>(for more information, see <a href="#">PLL Multiplier/Divider Definition</a> ). |
| 29h                   | 7:4                | PLL2_0N [3:0]  |                        |  |
|                       | 3:0                | PLL2_0R [8:5]  |                        |  |
| 2Ah                   | 7:3                | PLL2_0R[4:0]   |                        |  |
|                       | 2:0                | PLL2_0Q [5:3]  |                        |  |
| 2Bh                   | 7:5                | PLL2_0Q [2:0]  |                        |  |
|                       | 4:2                | PLL2_0P [2:0]  |                        |  |
|                       | 1:0                | VCO2_0_RANGE   | 00b                    |  |
| 2Ch                   | 7:0                | PLL2_1N [11:4] | 004h                   | PLL2_1 <sup>(5)</sup> : 30-bit multiplier/divider value for frequency $f_{VCO2\_1}$<br>(for more information, see <a href="#">PLL Multiplier/Divider Definition</a> ). |
| 2Dh                   | 7:4                | PLL2_1N [3:0]  |                        |  |
|                       | 3:0                | PLL2_1R [8:5]  |                        |  |
| 2Eh                   | 7:3                | PLL2_1R[4:0]   |                        |  |
|                       | 2:0                | PLL2_1Q [5:3]  |                        |  |
| 2Fh                   | 7:5                | PLL2_1Q [2:0]  |                        |  |
|                       | 4:2                | PLL2_1P [2:0]  |                        |  |
|                       | 1:0                | VCO2_1_RANGE   | 00b                    |  |

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

## 10 Application and Implementation

### NOTE

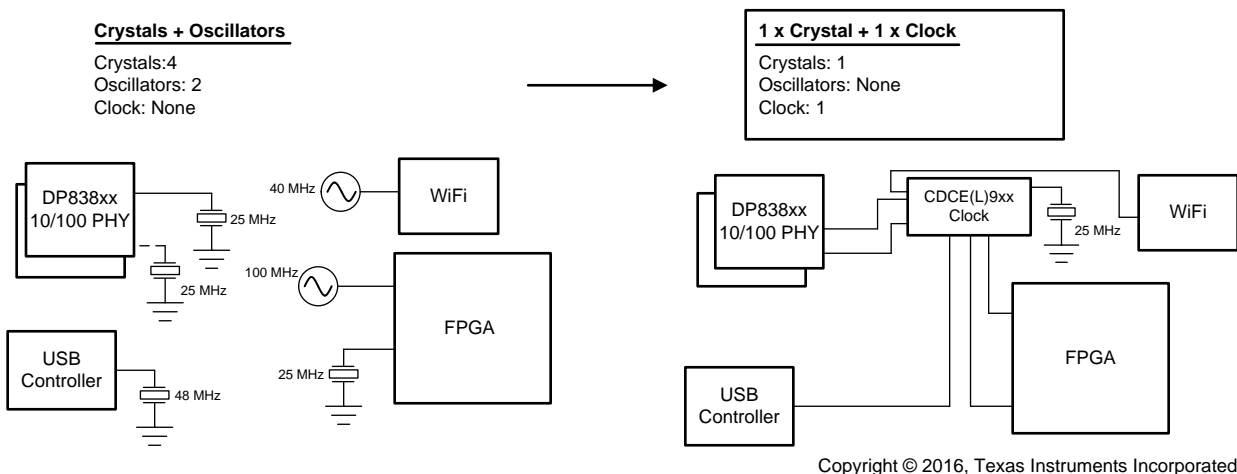
Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

### 10.1 Application Information

The CDCEx925 device is an easy-to-use high-performance, programmable CMOS clock synthesizer. It can be used as a crystal buffer, clock synthesizer with separate output supply pin. The CDCEx925 features an on-chip loop filter and Spread-spectrum modulation. Programming can be done through SPI, pin-mode, or using on-chip EEPROM. This section shows some examples of using CDCEx925 in various applications.

### 10.2 Typical Application

Figure 15 shows the use of the CDCEx925 devices for replacement of crystals and crystal oscillators on a Gigabit Ethernet Switch application.



**Figure 15. Crystal and Oscillator Replacement Example**

#### 10.2.1 Design Requirements

CDCEx925 supports spread spectrum clocking (SSC) with multiple control parameters:

- Modulation amount (%)
- Modulation frequency (>20 kHz)
- Modulation shape (triangular)
- Center spread / down spread ( $\pm$  or  $-$ )



## Typical Application (continued)

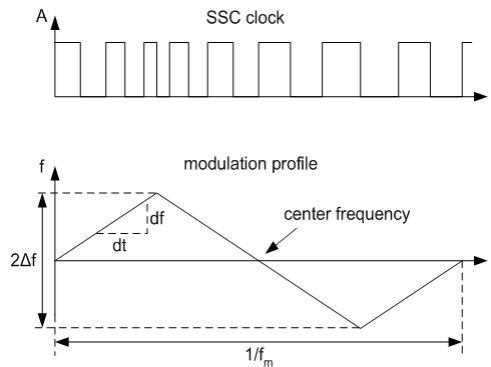
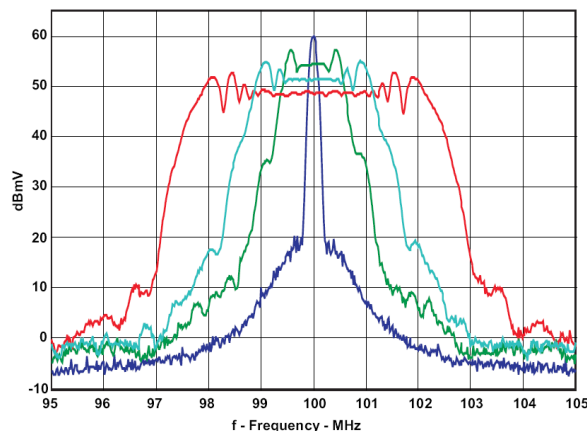


Figure 16. Modulation Frequency ( $f_m$ ) and Modulation Amount

### 10.2.2 Detailed Design Procedure

#### 10.2.2.1 Spread Spectrum Clock (SSC)

Spread spectrum modulation is a method to spread emitted energy over a larger bandwidth. In clocking, spread spectrum can reduce Electromagnetic Interference (EMI) by reducing the level of emission from clock distribution network.



CDCS502 with a 25-MHz Crystal, FS = 1,  $f_{OUT}$  = 100 MHz, and 0%,  $\pm 0.5$ ,  $\pm 1$ %, and  $\pm 2$ % SSC

Figure 17. Comparison Between Typical Clock Power Spectrum and Spread-Spectrum Clock

#### 10.2.2.2 PLL Multiplier/Divider Definition

At a given input frequency ( $f_{IN}$ ), the output frequency ( $f_{OUT}$ ) of the CDCE<sub>x</sub>925 is calculated with Equation 1.

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

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

The target VCO frequency ( $f_{VCO}$ ) of each PLL is calculated with Equation 2.

$$f_{VCO} = f_{IN} \times \frac{N}{M} \tag{2}$$

### Typical Application (continued)

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

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

where

- $N' = N \times 2^P$
- $N \geq M$
- $80 \text{ MHz} \leq f_{VCO} \leq 230 \text{ MHz}$
- $16 \leq q \leq 63$
- $0 \leq p \leq 4$
- $0 \leq r \leq 511$

(3)

#### Example:

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

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

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

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

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

#### 10.2.2.3 Crystal Oscillator Start-Up

When the CDCE925 is used as a crystal buffer, crystal oscillator start-up dominates the start-up time compared to the internal PLL lock time. The following diagram shows the oscillator start-up sequence for a 27-MHz crystal input with an 8-pF load. The start-up time for the crystal is in the order of approximately 250  $\mu\text{s}$  compared to approximately 10  $\mu\text{s}$  of lock time. In general, lock time is an order of magnitude less compared to the crystal start-up time.

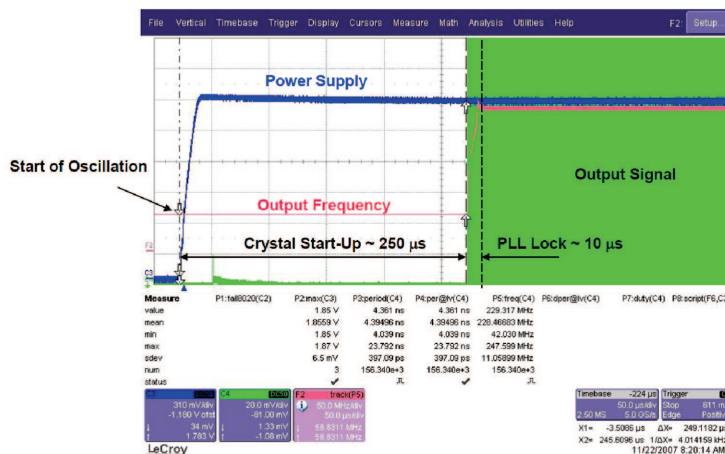
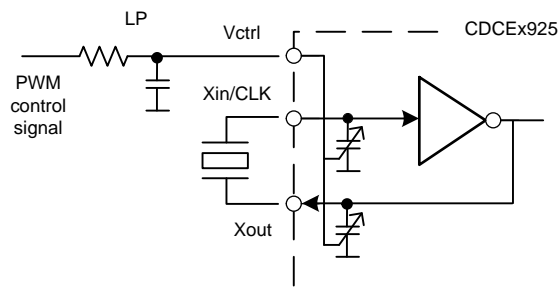


Figure 18. Crystal Oscillator Start-Up vs PLL Lock Time

#### 10.2.2.4 Frequency Adjustment With Crystal Oscillator Pulling

The frequency for the CDCE925 is adjusted for media and other applications with the VCXO control input  $V_{Ctrl}$ . If a PWM modulated signal is used as a control signal for the VCXO, an external filter is needed.

## Typical Application (continued)



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Figure 19. Frequency Adjustment Using PWM Input to the VCXO Control

### 10.2.2.5 Unused Inputs and Outputs

If VCXO pulling functionality is not required,  $V_{Ctrl}$  should be left floating. All other unused inputs should be set to GND. Unused outputs should be left floating.

If one output block is not used, TI recommends disabling it. However, TI always recommends providing the supply for the second output block even if it is disabled.

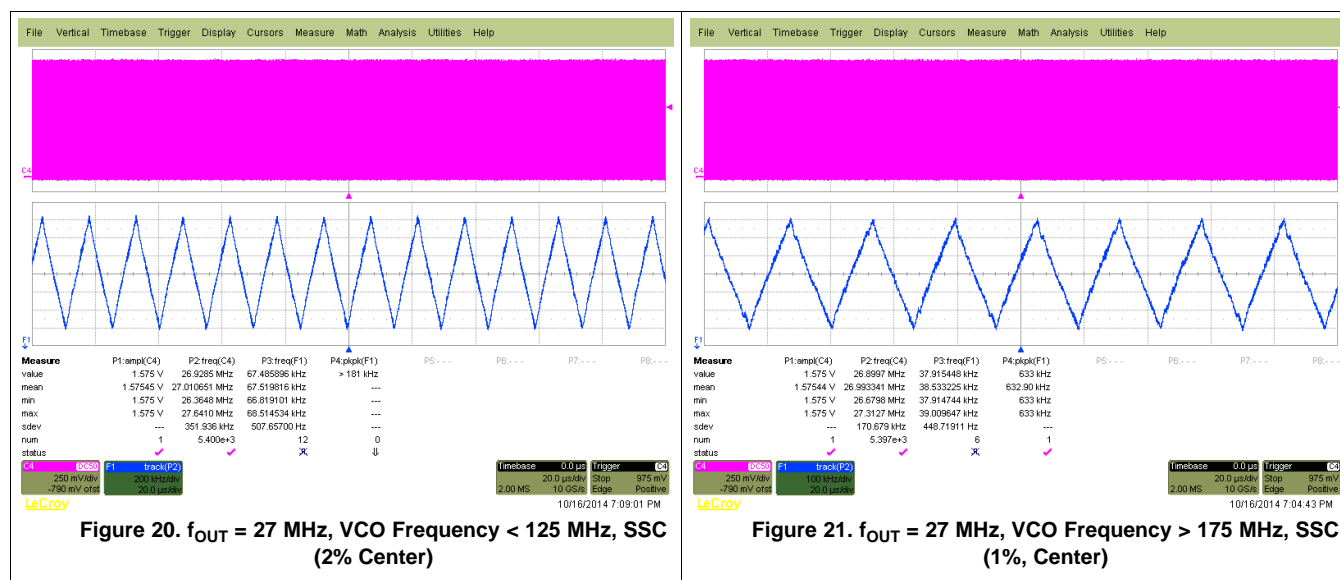
### 10.2.2.6 Switching Between XO and VCXO Mode

When the CDCE925 is in crystal oscillator or in VCXO configuration, the internal capacitors require different internal capacitance. The following steps are recommended to switch to VCXO mode when the configuration for the on-chip capacitor is still set for XO mode. To center the output frequency to 0 ppm:

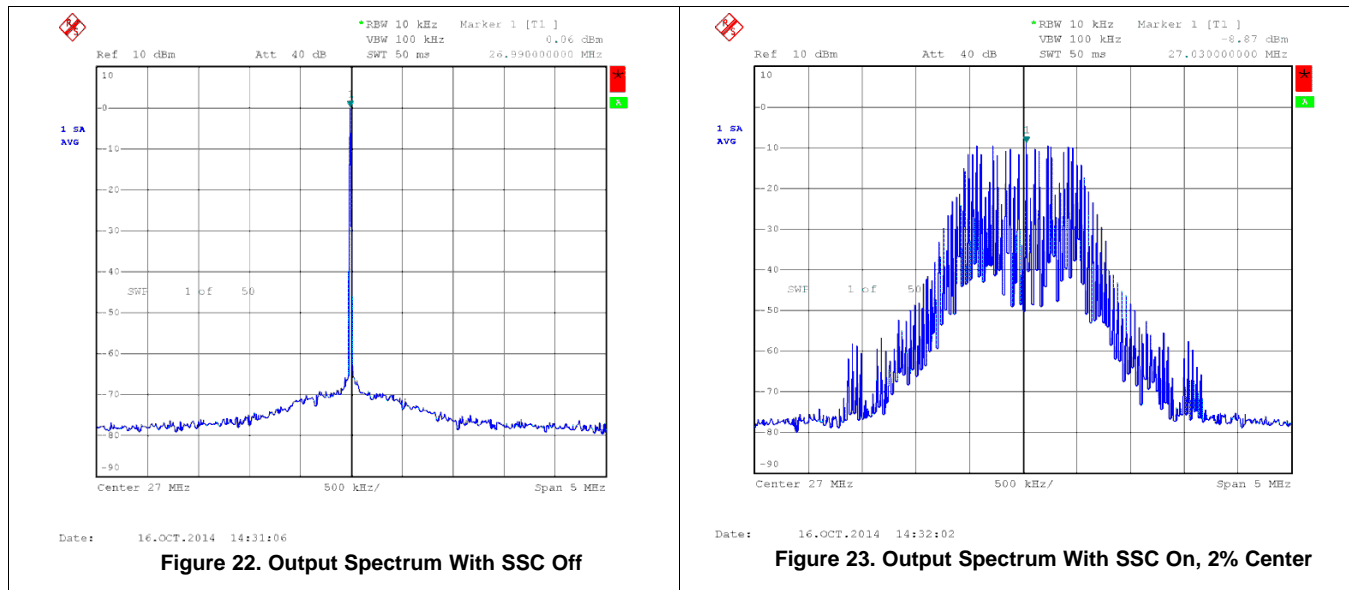
1. While in XO mode, put  $V_{Ctrl} = V_{dd}/2$
2. Switch from XO mode to VCXO mode
3. Program the internal capacitors to obtain 0 ppm at the output.

## 10.2.3 Application Curves

Figure 20, Figure 21, Figure 22, and Figure 23 show CDCE925 measurements with the SSC feature enabled. Device configuration: 27-MHz input, 27-MHz output.



Typical Application (continued)



11 Power Supply Recommendations

There is no restriction on the power-up sequence. In case the  $V_{DDOUT}$  is applied first, TI recommends grounding  $V_{DD}$ . In case the  $V_{DDOUT}$  is powered while  $V_{DD}$  is floating, there is a risk of high current flowing on the  $V_{DDOUT}$ .

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 3.3-V  $V_{DDOUT}$  available before the 1.8-V, the outputs stay disabled until the 1.8-V supply reaches a certain level.

12 Layout

12.1 Layout Guidelines

When the CDCE937 is used as a crystal buffer, any parasitics across the crystal affects the pulling range of the VCXO. Therefore, take care in placing the crystal units on the board. Crystals must be placed as close to the device as possible, ensuring that the routing lines from the crystal terminals to XIN and XOUT 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 capacitor.

To minimize the inductive influence of the trace, TI recommends placing this small capacitor as close to the device as possible and symmetrically with respect to XIN and XOUT.

Figure 24 shows a conceptual layout detailing recommended placement of power supply bypass capacitors on the basis of CDCE937. 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

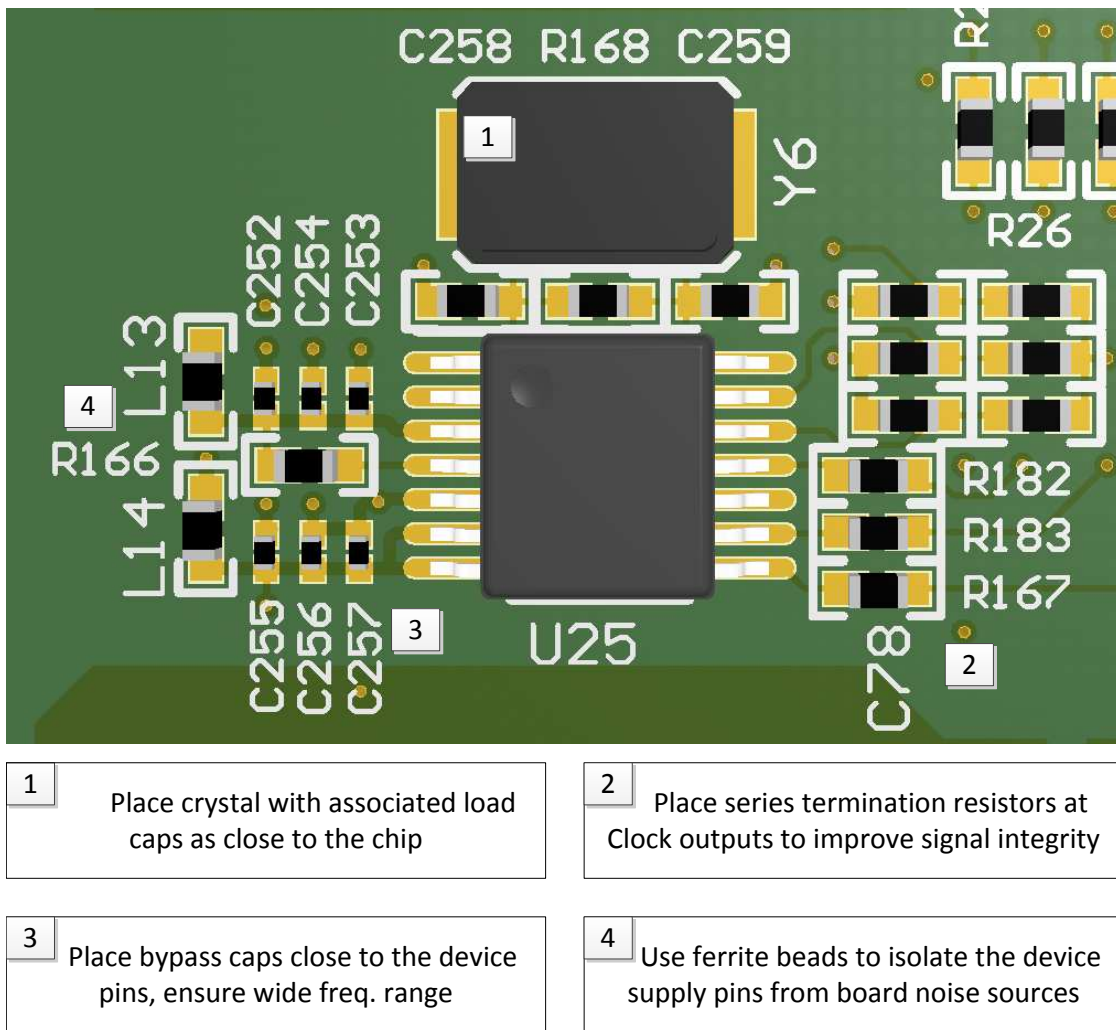


Figure 24. Annotated Layout

## 13 Device and Documentation Support

### 13.1 Device Support

#### 13.1.1 Third-Party Products Disclaimer

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#### 13.1.2 Development Support

For development support see the following:

- [SMBus](#)
- [I<sup>2</sup>C Bus](#)

### 13.2 Documentation Support

#### 13.2.1 Related Documentation

For related documentation see the following:

[VCXO Application Guideline for CDCE\(L\)9xx Family](#) (SCAA085)

### 13.3 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

**Table 12. Related Links**

| PARTS    | PRODUCT FOLDER             | SAMPLE & BUY               | TECHNICAL DOCUMENTS        | TOOLS & SOFTWARE           | SUPPORT & COMMUNITY        |
|----------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| CDCE925  | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| CDCEL925 | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |

### 13.4 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

### 13.5 Community Resources

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.

### 13.6 Trademarks

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Bluetooth is a registered trademark of Bluetooth SIG, Inc.

Ethernet is a trademark of Xerox Corporation.

All other trademarks are the property of their respective owners.

### 13.7 Electrostatic Discharge Caution



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

### 13.8 Glossary

[SLYZ022](#) — *TI Glossary*.

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

## 14 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2)         | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| CDCE925PW        | ACTIVE        | TSSOP        | PW              | 16   | 90          | Green (RoHS & no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | CDCE925                 | <a href="#">Samples</a> |
| CDCE925PWG4      | ACTIVE        | TSSOP        | PW              | 16   | 90          | Green (RoHS & no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | CDCE925                 | <a href="#">Samples</a> |
| CDCE925PWR       | ACTIVE        | TSSOP        | PW              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | CDCE925                 | <a href="#">Samples</a> |
| CDCE925PWRG4     | ACTIVE        | TSSOP        | PW              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | CDCE925                 | <a href="#">Samples</a> |
| CDCEL925PW       | ACTIVE        | TSSOP        | PW              | 16   | 90          | Green (RoHS & no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | CKEL925                 | <a href="#">Samples</a> |
| CDCEL925PWR      | ACTIVE        | TSSOP        | PW              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | CKEL925                 | <a href="#">Samples</a> |
| CDCEL925PWRG4    | ACTIVE        | TSSOP        | PW              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | CKEL925                 | <a href="#">Samples</a> |

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=100ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "-" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.



<sup>(6)</sup> Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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## TAPE AND REEL INFORMATION



### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



\*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 |
|-------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| CDCE925PWR  | TSSOP        | PW              | 16   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| CDCEL925PWR | 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) |
|-------------|--------------|-----------------|------|------|-------------|------------|-------------|
| CDCE925PWR  | TSSOP        | PW              | 16   | 2000 | 367.0       | 367.0      | 35.0        |
| CDCEL925PWR | TSSOP        | PW              | 16   | 2000 | 367.0       | 367.0      | 35.0        |



4220204/A 02/2017

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



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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

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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.

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