

LMK1C110x 1.8V、2.5V、3.3V LVCMOS クロック・バッファ・ファミリ

1 特長

- 高性能の 1:2、1:3、1:4 LVCMOS クロック・バッファ
- 非常に小さい出力スキュー: 50ps 未満
- 非常に小さい付加ジッタ: 50fs 未満
 - $V_{DD} = 3.3V$ で 7.5fs (標準値)
 - $V_{DD} = 2.5V$ で 10fs (標準値)
 - $V_{DD} = 1.8V$ で 19.2fs (標準値)
- 超低速伝播遅延: 3ns 未満
- 同期出力イネーブル
- 電源電圧: 3.3V、2.5V、1.8V
 - 3.3V トレラント入力機能 (すべての電源電圧で対応)
 - フェイルセーフ入力
- 3.3V で $f_{max} = 250MHz$
2.5V および 1.8V で $f_{max} = 200MHz$
- 動作温度範囲: $-40^{\circ}C \sim 125^{\circ}C$
- 8 ピンの TSSOP パッケージで供給
- 8 ピンの WSON パッケージで供給

2 アプリケーション

- ファクトリ・オートメーション / 制御
- 通信機器
- データ・センターおよびエンタープライズ・コンピューティング
- グリッド・インフラストラクチャ
- モーター・ドライブ
- 医療用画像処理

3 概要

LMK1C110x は、テキサス・インスツルメンツ製の高性能、低スキューのモジュール式汎用クロック・バッファ・ファミリです。このファミリはすべて、モジュール手法を考慮して設計されています。1:2、1:3、1:4 の 3 種類のファンアウト・バリエーションがあります。

このファミリに属するデバイスはすべて互いにピン互換であり、CDCLVC110x ファミリと後方互換性があるため扱いが簡単です。

ファミリのすべての製品は、小さい付加ジッタ、小さいスキュー、広い動作温度範囲などの高い性能を共有しています。

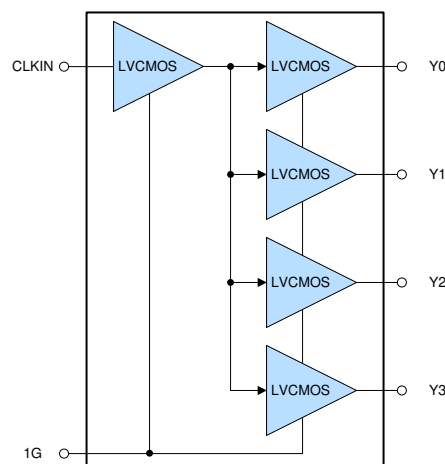
LMK1C110x は、1G が LOW になると出力を LOW 状態に切り換える同期出力イネーブル制御 (1G) をサポートしています。これらのデバイスにはフェイルセーフ入力があり、入力信号がない場合の出力の発振を防止し、VDD が供給される前に入力信号を受け入れます。

LMK1C110x ファミリは 1.8V、2.5V、3.3V 環境で動作し、 $-40^{\circ}C \sim 125^{\circ}C$ で動作が規定されています。

製品情報⁽¹⁾

| 部品番号 | パッケージ | 本体サイズ (公称) |
|-----------|-----------|-----------------|
| LMK1C1102 | TSSOP (8) | 3.00mm × 4.40mm |
| LMK1C1103 | | |
| LMK1C1104 | | |
| LMK1C1102 | WSON (8) | 2.00mm × 2.00mm |
| LMK1C1104 | | |

- (1) 利用可能なパッケージについては、このデータシートの末尾にある注文情報を参照してください。



機能ブロック図



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4 Revision History

| Changes from Revision C (June 2021) to Revision D (February 2022) | Page |
|--|-------------|
| • 「概要」セクションにフェイルセーフ入力の詳細を追加..... | 1 |
| • Changed part-to-part skew maximum from 450 ps to 250 ps..... | 6 |
| • Added the <i>Fail-Safe Inputs</i> section..... | 10 |
| Changes from Revision B (June 2020) to Revision C (June 2021) | Page |
| • 文書全体にわたってテキスト形式、表、図、相互参照の採番方法を変更..... | 1 |
| • LMK1C1102/04 DQF (WSON) パッケージを追加..... | 1 |
| • Added the <i>Device Comparison</i> table..... | 3 |
| • Added pinout diagrams for the DQF (WSON) package variant of the LMK1C1102 and LMK1C1104..... | 3 |
| • Added information pertaining to the layout of LMK1C1102/04 WSON package variant..... | 14 |
| • Removed <i>Related Links</i> section..... | 15 |
| Changes from Revision A (February 2020) to Revision B (June 2020) | Page |
| • 「概要」セクションにファンアウト・バリエーションの情報を追加..... | 1 |
| • 先頭ページから LMK1C1104PW のピン配置を削除..... | 1 |
| • Added LMK1C1102 and LMK1C1103 pinout diagrams..... | 3 |
| Changes from Revision * (December 2019) to Revision A (February 2020) | Page |
| • データシートに LMK1C1102 と LMK1C1103 を追加..... | 1 |
| • Changed the <i>Power Supply Recommendations</i> section..... | 13 |

5 Device Comparison

表 5-1. Device Comparison

| DEVICE | NUMBER OF OUTPUTS | PACKAGE |
|-----------|-------------------|-------------------------------|
| LMK1C1102 | 2 | TSSOP (8), 3.00 mm x 4.40 mm |
| LMK1C1103 | 3 | |
| LMK1C1104 | 4 | |
| LMK1C1106 | 6 | TSSOP (14), 5.00 mm x 4.40 mm |
| LMK1C1108 | 8 | TSSOP (16), 5.00 mm x 4.40 mm |
| LMK1C1102 | 2 | WSON (8), 2.00 mm x 2.00 mm |
| LMK1C1104 | 4 | |

6 Pin Configuration and Functions

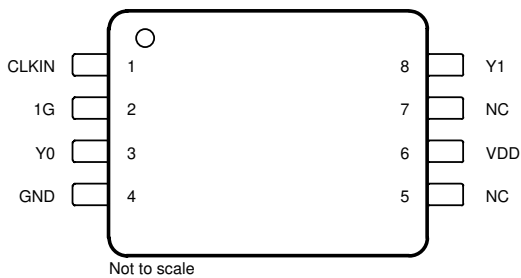
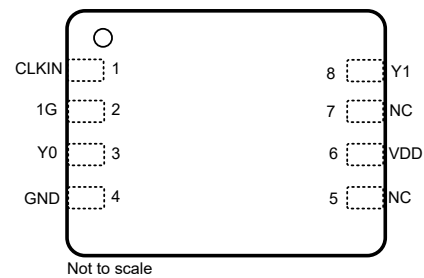


图 6-1. LMK1C1102 PW Package 8-Pin TSSOP Top View



1. The DQF (WSON) package is equivalent to the DFN package of other vendors.

图 6-2. LMK1C1102 DQF Package 8-Pin WSON Top View

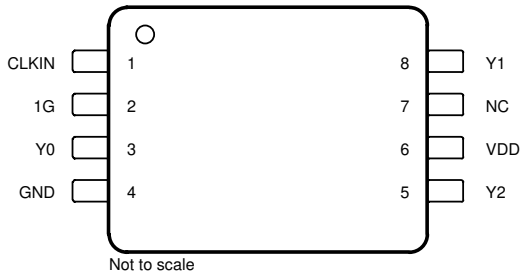


图 6-3. LMK1C1103 PW Package 8-Pin TSSOP Top View

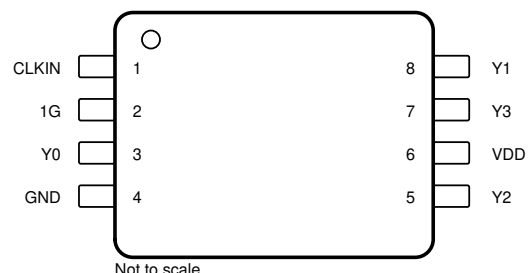
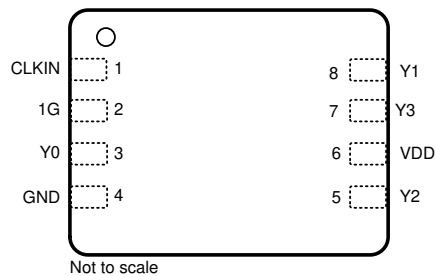


图 6-4. LMK1C1104 PW Package 8-Pin TSSOP Top View



1. The DQF (WSON) package is equivalent to the DFN package of other vendors.

图 6-5. LMK1C1104 DQF Package 8-Pin WSON Top View

表 6-1. Pin Functions

| NAME | PIN | | | TYPE | DESCRIPTION |
|-----------------------------|------------|------------|------------|--------|---|
| | LMK1C 1102 | LMK1C 1103 | LMK1C 1104 | | |
| LVC MOS CLOCK INPUT | | | | | |
| CLKIN | 1 | 1 | 1 | Input | Single-ended clock input with internal 300-kΩ (typical) pulldown resistor to GND. Typically connected to a single-ended clock input. |
| CLOCK OUTPUT ENABLE | | | | | |
| 1G | 2 | 2 | 2 | Input | Global Output Enable with internal 300-kΩ (typical) pulldown resistor to GND. Typically connected to VDD with external pullup resistor. HIGH: outputs enabled LOW: outputs disabled |
| LVC MOS CLOCK OUTPUT | | | | | |
| Y0 | 3 | 3 | 3 | Output | LVC MOS output. Typically connected to a receiver. Unused outputs can be left floating. |
| Y1 | 8 | 8 | 8 | | |
| Y2 | — | 5 | 5 | | |
| Y3 | — | — | 7 | | |
| SUPPLY VOLTAGE | | | | | |
| VDD | 6 | 6 | 6 | Power | Power supply terminal. Typically connected to a 3.3-V, 2.5-V, or 1.8-V supply. The VDD pin is typically connected to an external 0.1-μF capacitor near the pin. |
| GROUND | | | | | |
| GND | 4 | 4 | 4 | GND | Power supply ground. |

7 Specifications

7.1 Absolute Maximum Ratings

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

| | | MIN | MAX | UNIT |
|--------------------|---------------------------|------|-----------------------|------|
| V _{DD} | Supply voltage | -0.5 | 3.6 | V |
| V _{CLKIN} | Input voltage (CLKIN) | | | |
| V _{IN} | Input voltage (1G) | | | |
| V _{Yn} | Output pins (Yn) | -0.5 | V _{DD} + 0.3 | |
| I _{IN} | Input current | -20 | 20 | mA |
| I _O | Continuous output current | -50 | 50 | mA |
| T _{stg} | Storage temperature | -65 | 150 | °C |

- (1) Operation outside the *Absolute Maximum Ratings* may cause permanent device damage. *Absolute Maximum Ratings* do not imply functional operation of the device at these or any other conditions beyond those listed under *Recommended Operating Conditions*. If used outside the *Recommended Operating Conditions* but within the *Absolute Maximum Ratings*, the device may not be fully functional, and this may affect device reliability, functionality, performance, and shorten the device lifetime.

7.2 ESD Ratings

| | | | VALUE | UNIT |
|--------------------|-------------------------|--|-------|------|
| V _(ESD) | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/ JEDEC JS-001, all pins ⁽¹⁾ | ±9000 | V |
| | | Charged device model (CDM), per JEDEC specification JESD22-C101, all pins ⁽²⁾ | ±1500 | |

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

7.3 Recommended Operating Conditions

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

| | | | MIN | NOM | MAX | UNIT |
|-----------------|--------------------------------|--------------|-------|-----|-------|------|
| V _{DD} | Core supply voltage | 3.3-V supply | 3.135 | 3.3 | 3.465 | V |
| | | 2.5-V supply | 2.375 | 2.5 | 2.625 | |
| | | 1.8-V supply | 1.71 | 1.8 | 1.89 | |
| T _A | Operating free-air temperature | | -40 | | 125 | °C |
| T _J | Operating junction temperature | | -40 | | 150 | °C |

7.4 Thermal Information

| THERMAL METRIC ⁽¹⁾ | | LMK1C1104 | | UNIT |
|-------------------------------|--|-----------|------------|------|
| | | DQF(WSON) | PW (TSSOP) | |
| | | 8 PINS | 8 PINS | |
| R _{qJA} | Junction-to-ambient thermal resistance | 163 | 181.9 | °C/W |
| R _{qJC(top)} | Junction-to-case (top) thermal resistance | 105.7 | 76.6 | °C/W |
| R _{qJB} | Junction-to-board thermal resistance | 84.2 | 111.6 | °C/W |
| Y _{JT} | Junction-to-top characterization parameter | 16.7 | 16 | °C/W |
| Y _{JB} | Junction-to-board characterization parameter | 83.9 | 110.1 | °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

V_{DD} = 3.3 V ± 5 %, -40°C ≤ TA ≤ 125°C. Typical values are at V_{DD} = 3.3 V, 25°C (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---------------------------------------|--|-----------------------|------|-----------------------|---------|
| CURRENT CONSUMPTION | | | | | | |
| I _{DD} | Core supply current, static | All-outputs disabled, f _{IN} = 0 V | | 25 | 45 | μA |
| I _{DD} | Core supply current | All-outputs disabled, f _{IN} = 100 MHz | | 8 | 15 | mA |
| | | All-outputs active, f _{IN} = 100 MHz, C _L = 5pF, V _{DD} = 1.8 V | | 14 | 20 | |
| | | All-outputs active, f _{IN} = 100 MHz, C _L = 5pF, V _{DD} = 2.5 V | | 21 | 30 | |
| | | All-outputs active, f _{IN} = 100 MHz, C _L = 5pF, V _{DD} = 3.3 V | | 33 | 40 | |
| CLOCK INPUT | | | | | | |
| f _{IN_SE} | Input frequency | V _{DD} = 3.3 V | DC | | 250 | MHz |
| | | V _{DD} = 2.5 V and 1.8 V | DC | | 200 | |
| V _{IH} | Input high voltage | | 0.7 x V _{DD} | | | V |
| V _{IL} | Input low voltage | | | | 0.3 x V _{DD} | |
| dV _{IN} /dt | Input slew rate | 20% - 80% of input swing | 0.1 | | | V/ns |
| I _{IN_LEAK} | Input leakage current | | -50 | | 50 | uA |
| C _{IN_SE} | Input capacitance | at 25°C | | 7 | | pF |
| CLOCK OUTPUT FOR ALL V_{DD} LEVELS | | | | | | |
| f _{OUT} | Output frequency | V _{DD} = 3.3 V | | | 250 | MHz |
| | | V _{DD} = 2.5 V and 1.8 V | | | 200 | |
| ODC | Output duty cycle | With 50% duty cycle input (for all V _{DD}) | 45 | | 55 | % |
| t _{START} | Start-up time before output is active | See (1) | | | 3 | ms |
| t _{1G_ON} | Output enable time | See (2) | | | 5 | cycles |
| t _{1G_OFF} | Output disable time | See (3) | | | 5 | cycles |
| CLOCK OUTPUT FOR V_{DD} = 3.3 V ± 5% | | | | | | |
| V _{OH} | Output high voltage | I _{OH} = 1 mA | 2.8 | | | V |
| V _{OL} | Output low voltage | I _{OL} = 1 mA | | | 0.2 | |
| t _{RISE-FALL} | Output rise and fall time | 20/80%, C _L = 5 pF, f _{IN} = 156.25 MHz | | 0.35 | 0.7 | ns |
| t _{OUTPUT-SKEW} | Output-output skew | See (4) | | 25 | 50 | ps |
| t _{PART-SKEW} | Part-to-part skew | | | | 250 | |
| t _{PROP-DELAY} | Propagation delay | See (5) | | 1.5 | 2 | ns |
| t _{JITTER-ADD} | Additive Jitter | f _{IN} = 156.25 MHz, Input slew rate = 2 V/ns, Integration range = 12 kHz - 20 MHz | | 8 | 20 | fs, RMS |
| R _{OUT} | Output impedance | | | 50 | | Ω |
| CLOCK OUTPUT FOR V_{DD} = 2.5 V ± 5% | | | | | | |
| V _{OH} | Output high voltage | I _{OH} = 1 mA | 0.8 x V _{DD} | | | V |
| V _{OL} | Output low voltage | I _{OL} = 1 mA | | | 0.2 x V _{DD} | |
| t _{RISE-FALL} | Output rise and fall time | 20/80%, C _L = 5 pF, f _{IN} = 156.25 MHz | | 0.33 | 0.8 | ns |
| t _{OUTPUT-SKEW} | Output-output skew | See (4) | | | 50 | ps |
| t _{PART-SKEW} | Part-to-part skew | | | | 400 | |
| t _{PROP-DELAY} | Propagation delay | See (5) | | 1.5 | 2.5 | ns |
| t _{JITTER-ADD} | Additive Jitter | f _{IN} = 156.25 MHz, Input slew rate = 2 V/ns, Integration range = 12 kHz - 20 MHz | | 11 | 27 | fs, RMS |
| R _{OUT} | Output impedance | | | 52.5 | | Ω |

VDD = 3.3 V ± 5 %, -40°C ≤ TA ≤ 125°C. Typical values are at VDD = 3.3 V, 25°C (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--|---------------------------|---|------------------------|------|-----|---------|
| CLOCK OUTPUT FOR VDD = 1.8 V ± 5% | | | | | | |
| V _{OH} | Output high voltage | I _{OH} = 1 mA | 0.8 x V _{DD} | | | V |
| V _{OL} | Output low voltage | I _{OL} = 1 mA | 0.2 x V _{DD} | | | |
| t _{RISE-FALL} | Output rise and fall time | 20/80%, C _L = 5 pF, f _{IN} = 156.25 MHz | | 0.38 | 1 | ns |
| t _{OUTPUT-SKEW} | Output-output skew | See (4) | | | 50 | ps |
| t _{PART-SKEW} | Part-to-part skew | | | | 900 | ps |
| t _{PROP-DELAY} | Propagation delay | See (5) | | 1.5 | 3 | ns |
| t _{JITTER-ADD} | Additive Jitter | f _{IN} = 156.25 MHz, Input slew rate = 2 V/ns, Integration range = 12 kHz - 20 MHz | | 17.5 | 50 | fs, RMS |
| R _{OUT} | Output impedance | | | 60 | | Ω |
| GENERAL PURPOSE INPUT (1G) | | | | | | |
| V _{IH} | High-level input voltage | | 0.75 x V _{DD} | | | V |
| V _{IL} | Low-level input voltage | | 0.25 x V _{DD} | | | |
| I _{IH} | Input high-level current | V _{IH} = V _{DD_REF} | -50 | | 50 | μA |
| I _{IL} | Input low-level current | V _{IL} = GND | -50 | | 50 | |

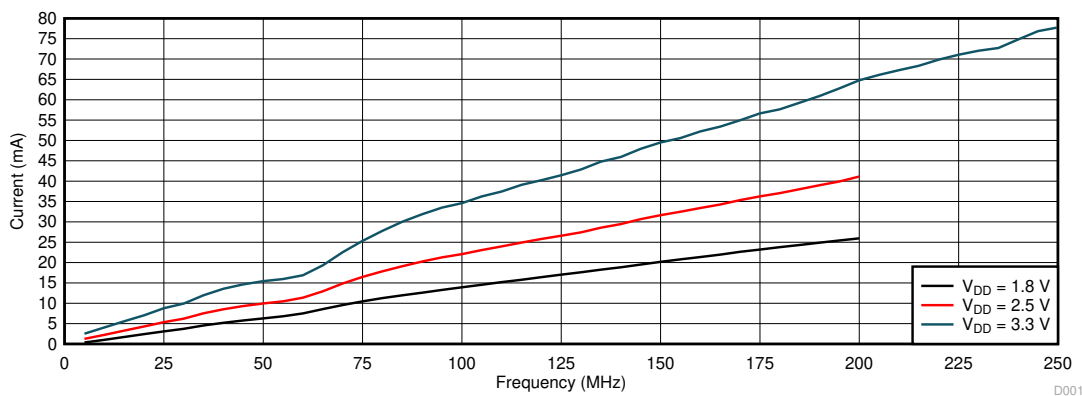
- (1) Measured from VDD stable to output active, when 1G = HIGH.
- (2) Measured from 1G rising edge crossing V_{IH} to first rising edge of Y_n.
- (3) Measured from 1G falling edge crossing V_{IL} to last falling edge of Y_n.
- (4) Measured from rising edge of any Y_n output to any other Y_m output.
- (5) Measured from rising edge of CLKIN to any Y_n output.

7.6 Timing Requirements

VDD = 3.3 V ± 5 %, -40°C ≤ TA ≤ 125°C

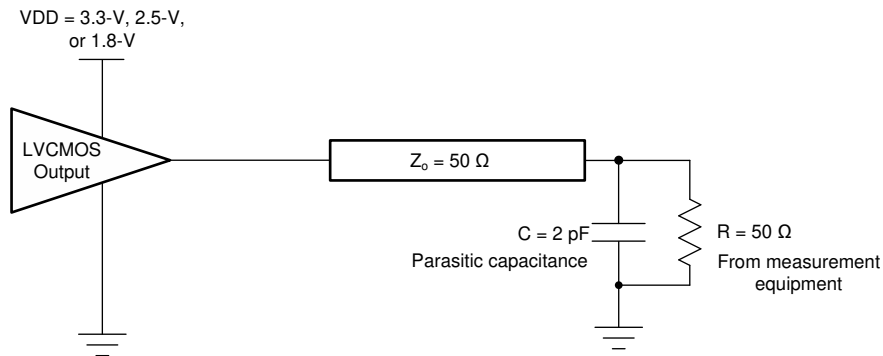
| | | MIN | NOM | MAX | UNIT |
|---------------------|---------------------------|-----|-----|-----|------|
| POWER SUPPLY | | | | | |
| V/t _{RAMP} | V _{DD} ramp rate | 0.1 | | 50 | V/ms |

7.7 Typical Characteristics

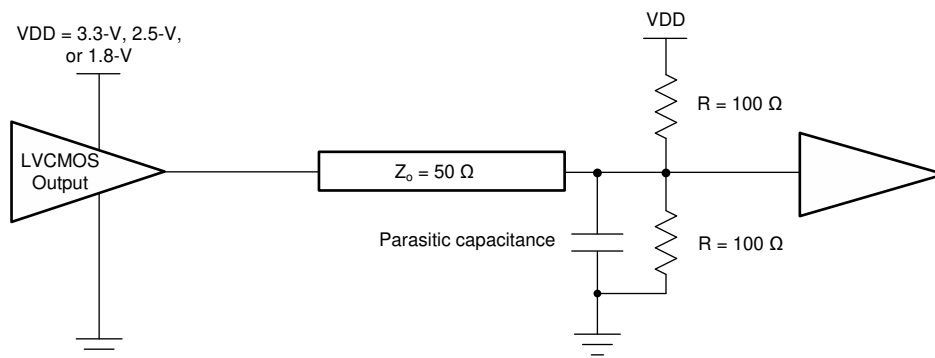


7-1. Device Power Consumption vs. Clock Frequency (Load 5 pF)

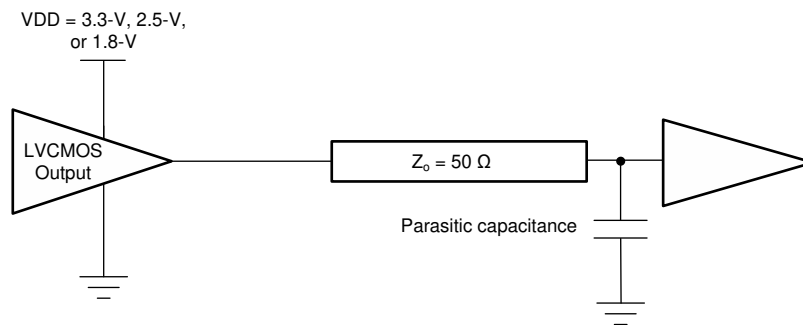
8 Parameter Measurement Information



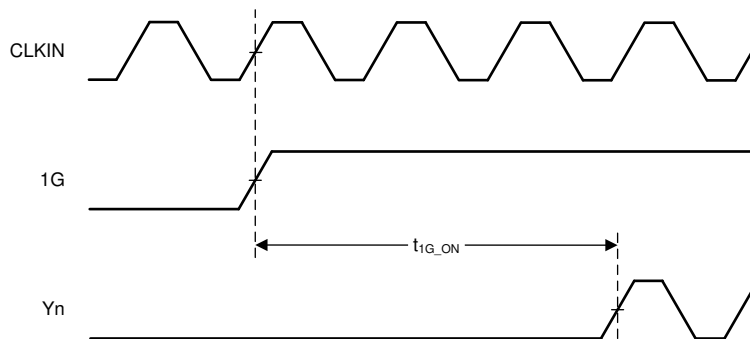
8-1. Test Load Circuit



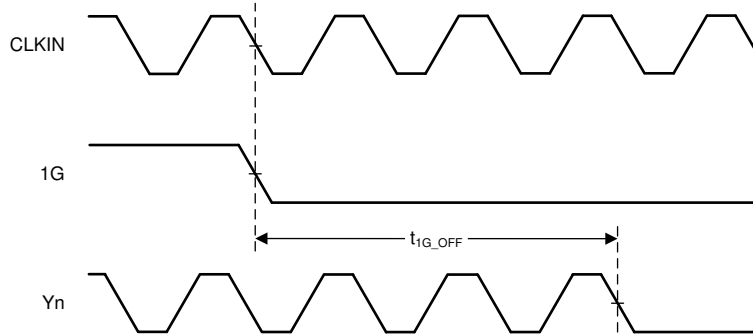
8-2. Application Load With 50-ohm Termination



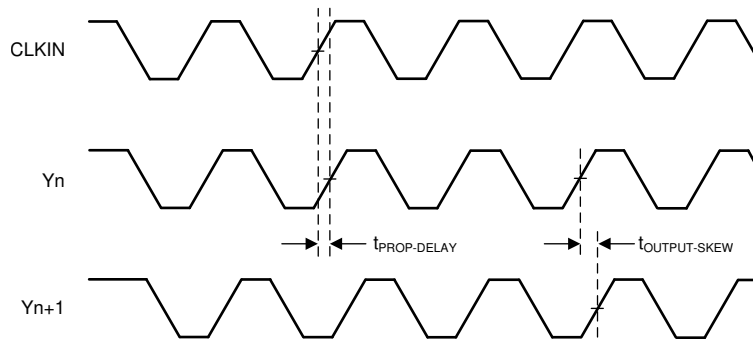
8-3. Application Load With Termination



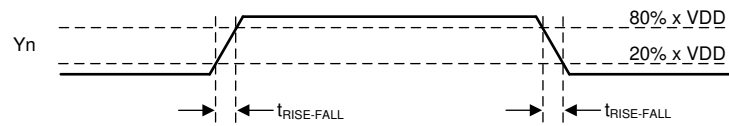
8-4. t_{1G_ON} Output Enable Time



8-5. t_{1G_OFF} Output Disable Time



8-6. Propagation Delay t_{PROP_DELAY} and Output Skew t_{OUTPUT_SKEW}



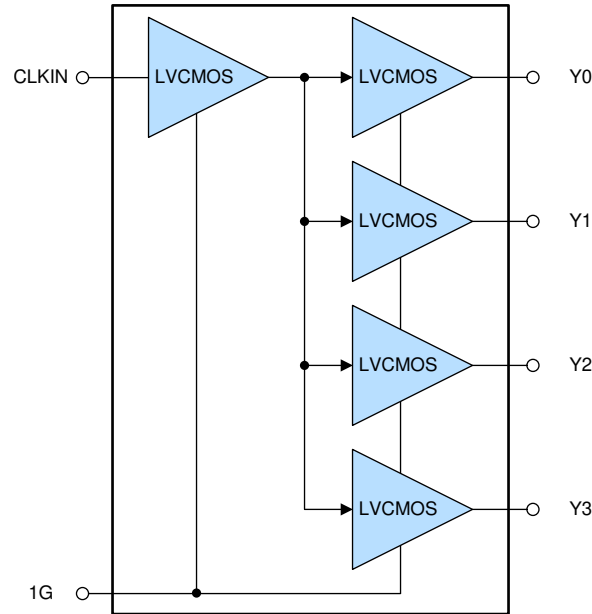
8-7. Rise and Fall Time t_{RISE_FALL}

9 Detailed Description

9.1 Overview

The LMK1C110x family of devices is part of a low-jitter and low-skew LVCMOS fan-out buffer solution. For best signal integrity, it is important to match the characteristic impedance of the LMK1C110x's output driver with that of the transmission line.

9.2 Functional Block Diagram



9.3 Feature Description

The outputs of the LMK1C110x can be disabled by driving the synchronous output enable pin (1G) low. Unused output can be left floating to reduce overall system component cost. Supply and ground pins must be connected to V_{DD} and GND, respectively.

9.3.1 Fail-Safe Inputs

The LMK1C110x family of devices is designed to support fail-safe input operation. This feature allows the user to drive the device inputs before VDD is applied without damaging the device. Refer to [Absolute Maximum Ratings](#) for more information on the maximum input supported by the device. The device also incorporates an input hysteresis that prevents random oscillation in absence of an input signal, allowing the input pins to be left open.

9.4 Device Functional Modes

The LMK1C110x operates from 1.8-V, 2.5-V, or 3.3-V supplies. 表 9-1 shows the output logics of the LMK1C110x.

表 9-1. Output Logic Table

| INPUTS | | OUTPUTS |
|--------|----|---------|
| CLKIN | 1G | Yn |
| X | L | L |
| L | H | L |
| H | H | H |

10 Application and Implementation

Note

以下のアプリケーション情報は、TI の製品仕様に含まれるものではなく、TI ではその正確性または完全性を保証いたしません。個々の目的に対する製品の適合性については、お客様の責任で判断していただくこととなります。お客様は自身の設計実装を検証しテストすることで、システムの機能を確認する必要があります。

10.1 Application Information

The LMK1C110x family is a low additive jitter LVCMOS buffer solution that can operate up to 250-MHz at $V_{DD} = 3.3\text{ V}$ and 200 MHz at $V_{DD} = 2.5\text{ V}$ to 1.8 V. Low output skew as well as the ability for synchronous output enable is featured to simultaneously enable or disable buffered clock outputs as necessary in the application.

10.2 Typical Application

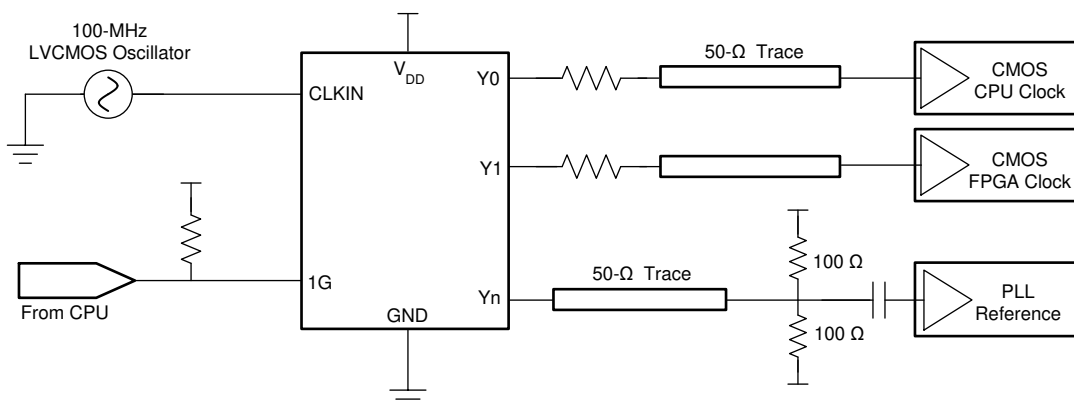


Figure 10-1. System Configuration Example

10.2.1 Design Requirements

The LMK1C110x shown in Figure 10-1 is configured to fan out a 100-MHz signal from a local LVCMOS oscillator. The CPU is configured to control the output state through 1G.

The configuration example is driving three LVCMOS receivers in a backplane application with the following properties:

- The CPU clock can accept a full swing DC-coupled LVCMOS signal. A series resistor is placed near the LMK1C110x to closely match the characteristic impedance of the trace to minimize reflections.
- The FPGA clock is similarly DC-coupled with an appropriate series resistor placed near the LMK1C110x.
- The PLL in this example can accept a lower amplitude signal, so a Thevenin's equivalent termination is used. The PLL receiver features internal biasing, so AC coupling can be used when common-mode voltage is mismatched.

10.2.2 Detailed Design Procedure

Unused outputs can be left floating. See the [Power Supply Recommendations](#) section for recommended filtering techniques.

10.2.3 Application Curves

The low additive jitter of the LMK1C110x is shown in Figure 10-2.

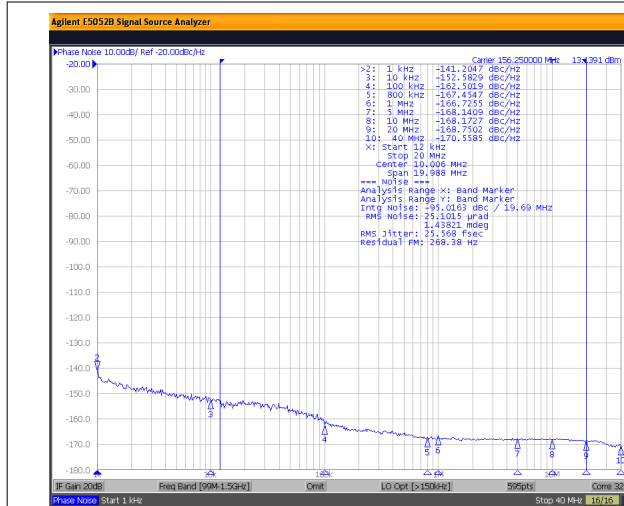
Figure 10-3 shows the low-noise 156.25-MHz reference source with 25.6-fs RMS jitter driving the LMK1C110x, resulting in 26.7-fs RMS jitter when integrated from 12 kHz to 20 MHz at 3.3-V supply. The resultant additive jitter measured is a low 7.6-fs RMS for this configuration.

LMK1C1102, LMK1C1103, LMK1C1104

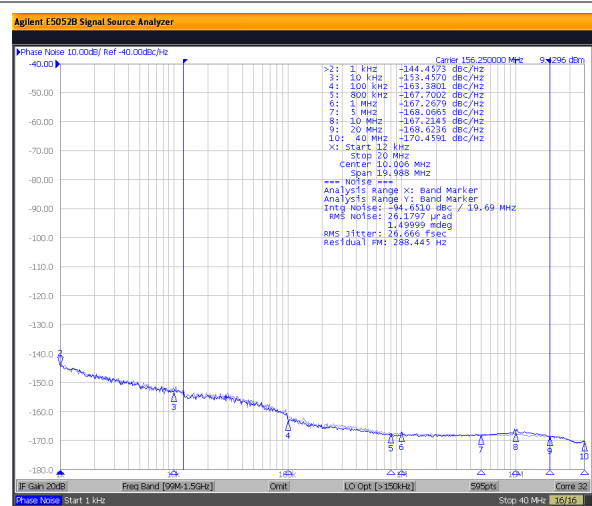
JAJ5IA5D – DECEMBER 2019 – REVISED FEBRUARY 2022

☒ 10-4 shows the low-noise 156.25-MHz reference source with 25.6-fs RMS jitter driving the LMK1C110x, resulting in 27.5-fs RMS jitter when integrated from 12 kHz to 20 MHz at 2.5-V supply. The resultant additive jitter measured is a low 10-fs RMS for this configuration.

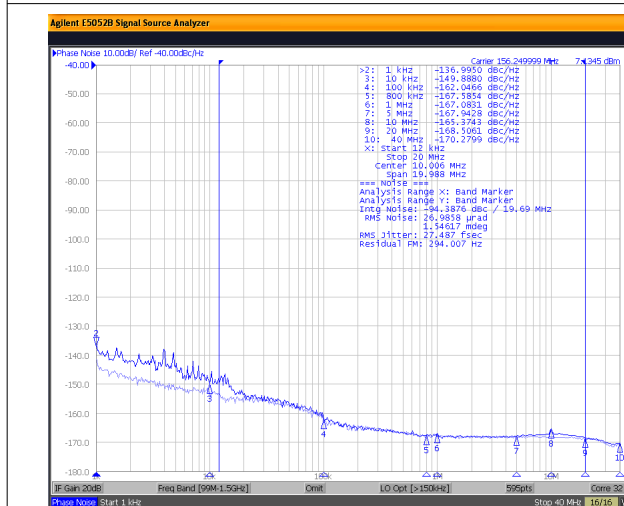
☒ 10-5 shows the low-noise 156.25-MHz reference source with 25.6-fs RMS jitter driving the LMK1C110x, resulting in 32-fs RMS jitter when integrated from 12 kHz to 20 MHz at 1.8-V supply. The resultant additive jitter measured is a low 19.2-fs RMS for this configuration.



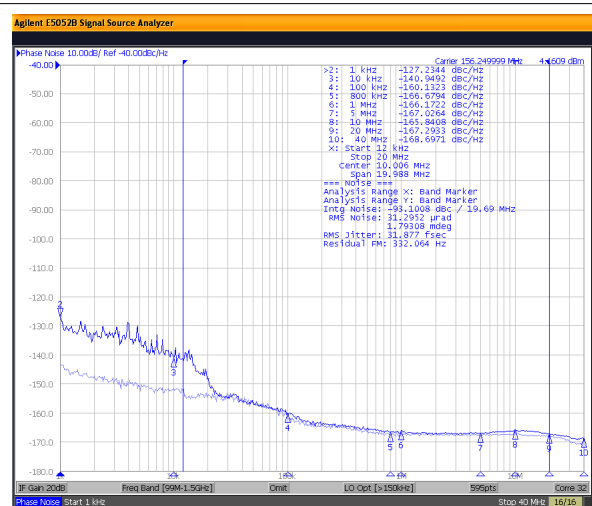
☒ 10-2. LMK1C110x Reference Phase Noise 25.6-fs (12 kHz to 20 MHz)



☒ 10-3. LMK1C110x 3.3-V Output Phase Noise 26.7-fs (12 kHz to 20 MHz)



☒ 10-4. LMK1C110x 2.5-V Output Phase Noise 27.5-fs (12 kHz to 20 MHz)



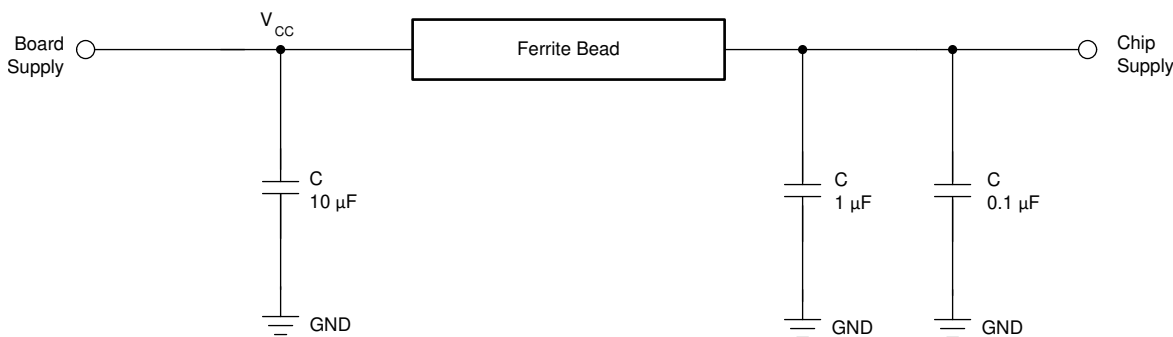
☒ 10-5. LMK1C110x 1.8-V Output Phase Noise 32-fs (12 kHz to 20 MHz)

11 Power Supply Recommendations

High-performance clock buffers can be sensitive to noise on the power supply, which may dramatically increase the additive jitter of the buffer. Thus, it is essential to manage any excessive noise from the system power supply, especially for applications where the jitter and phase noise performance is critical.

Filter capacitors are used to eliminate the low-frequency noise from the power supply, where the bypass capacitors provide the very low impedance path for high-frequency noise and guard the power supply system against induced fluctuations. These bypass capacitors also provide instantaneous current surges as required by the device and should have low equivalent series resistance (ESR). To properly bypass the supply, the decoupling capacitors must be placed very close to the power-supply terminals, be connected directly to the ground plane, and laid out with short loops to minimize inductance. TI recommends adding as many high-frequency (for example, 0.1 μF) bypass capacitors, as there are supply terminals in the package. TI recommends, but does not require, inserting a ferrite bead between the board power supply and the chip power supply that isolates the high-frequency switching noises generated by the clock buffer; these beads prevent the switching noise from leaking into the board supply. It is imperative to choose an appropriate ferrite bead with very low DC resistance to provide adequate isolation between the board supply and the chip supply, as well as to maintain a voltage at the supply terminals that is greater than the minimum voltage required for proper operation.

☒ 11-1 shows this recommended power supply decoupling method.



☒ 11-1. Power Supply Decoupling

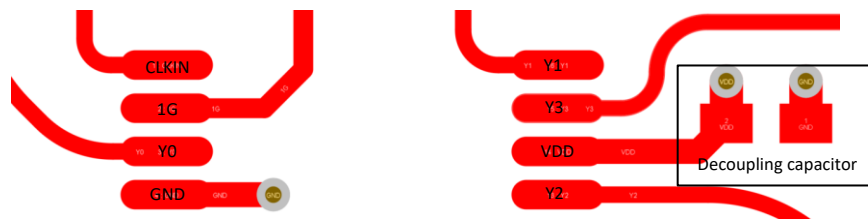
12 Layout

12.1 Layout Guidelines

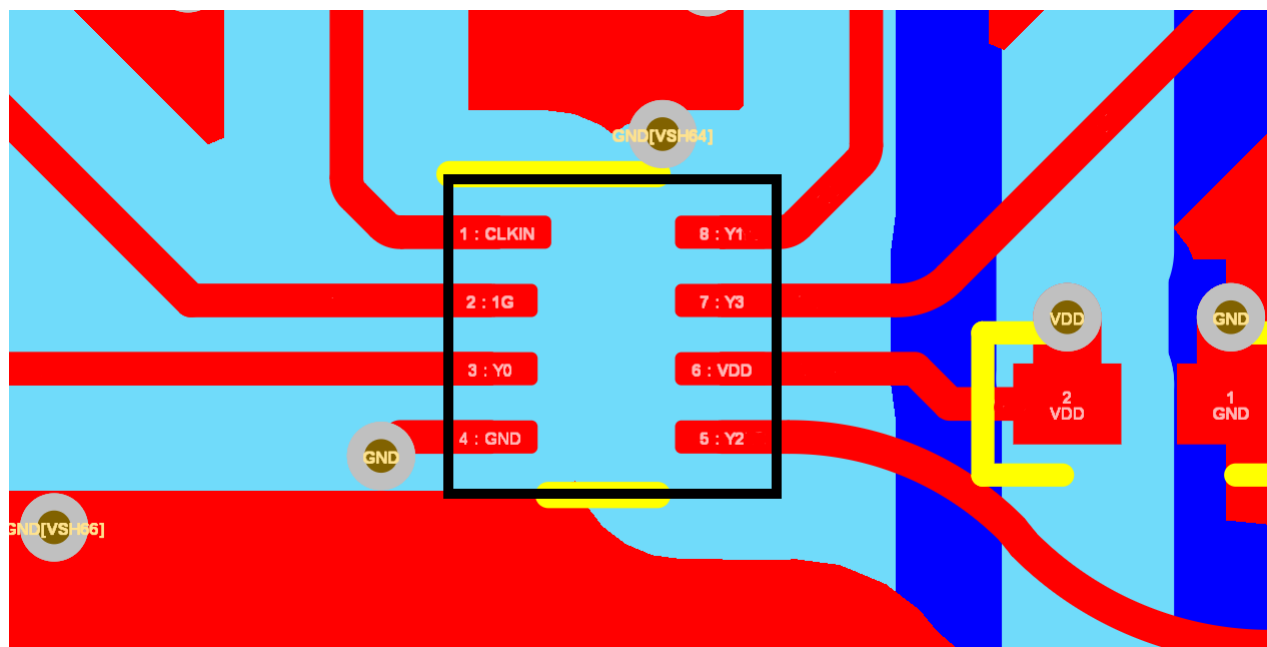
☒ 12-1 shows a conceptual layout detailing recommended placement of power supply bypass capacitors. For component side mounting, use 0402 body size capacitors to facilitate signal routing. Keep the connections between the bypass capacitors and the power supply on the device as short as possible. Ground the other side of the capacitor using a low-impedance connection to the ground plane.

☒ 12-2 provides a visual representation of the WSON device; it can be seen from the figure that similar to a DFN package, WSON doesn't have any leads.

12.2 Layout Example



☒ 12-1. PCB Conceptual Layout



☒ 12-2. Layout illustration for 8-pin WSON device

13 Device and Documentation Support

13.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](https://www.ti.com). Click on *Subscribe to updates* 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.

13.2 サポート・リソース

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13.3 Trademarks

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13.4 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

13.5 Glossary

[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 part number | Status (1) | Material type (2) | Package Pins | Package qty Carrier | RoHS (3) | Lead finish/ Ball material (4) | MSL rating/ Peak reflow (5) | Op temp (°C) | Part marking (6) |
|-------------------------------|---------------|----------------------|----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| LMK1C1102DQFR | Active | Production | WSON (DQF) 8 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | L1C2 |
| LMK1C1102DQFR.A | Active | Production | WSON (DQF) 8 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | L1C2 |
| LMK1C1102DQFT | Active | Production | WSON (DQF) 8 | 250 SMALL T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | L1C2 |
| LMK1C1102DQFT.A | Active | Production | WSON (DQF) 8 | 250 SMALL T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | L1C2 |
| LMK1C1102PWR | Active | Production | TSSOP (PW) 8 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LMK1C2 |
| LMK1C1102PWR.A | Active | Production | TSSOP (PW) 8 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LMK1C2 |
| LMK1C1102PWRG4 | Active | Production | TSSOP (PW) 8 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LMK1C2 |
| LMK1C1102PWRG4.A | Active | Production | TSSOP (PW) 8 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LMK1C2 |
| LMK1C1103PWR | Active | Production | TSSOP (PW) 8 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LMK1C3 |
| LMK1C1103PWR.A | Active | Production | TSSOP (PW) 8 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LMK1C3 |
| LMK1C1103PWRG4 | Active | Production | TSSOP (PW) 8 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LMK1C3 |
| LMK1C1103PWRG4.A | Active | Production | TSSOP (PW) 8 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LMK1C3 |
| LMK1C1104DQFR | Active | Production | WSON (DQF) 8 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | L1C4 |
| LMK1C1104DQFR.A | Active | Production | WSON (DQF) 8 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | L1C4 |
| LMK1C1104DQFT | Active | Production | WSON (DQF) 8 | 250 SMALL T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | L1C4 |
| LMK1C1104DQFT.A | Active | Production | WSON (DQF) 8 | 250 SMALL T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | L1C4 |
| LMK1C1104PWR | Active | Production | TSSOP (PW) 8 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LMK1C4 |
| LMK1C1104PWR.A | Active | Production | TSSOP (PW) 8 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LMK1C4 |
| LMK1C1104PWRG4 | Active | Production | TSSOP (PW) 8 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LMK1C4 |
| LMK1C1104PWRG4.A | Active | Production | TSSOP (PW) 8 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LMK1C4 |

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

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

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

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

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

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

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

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TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE

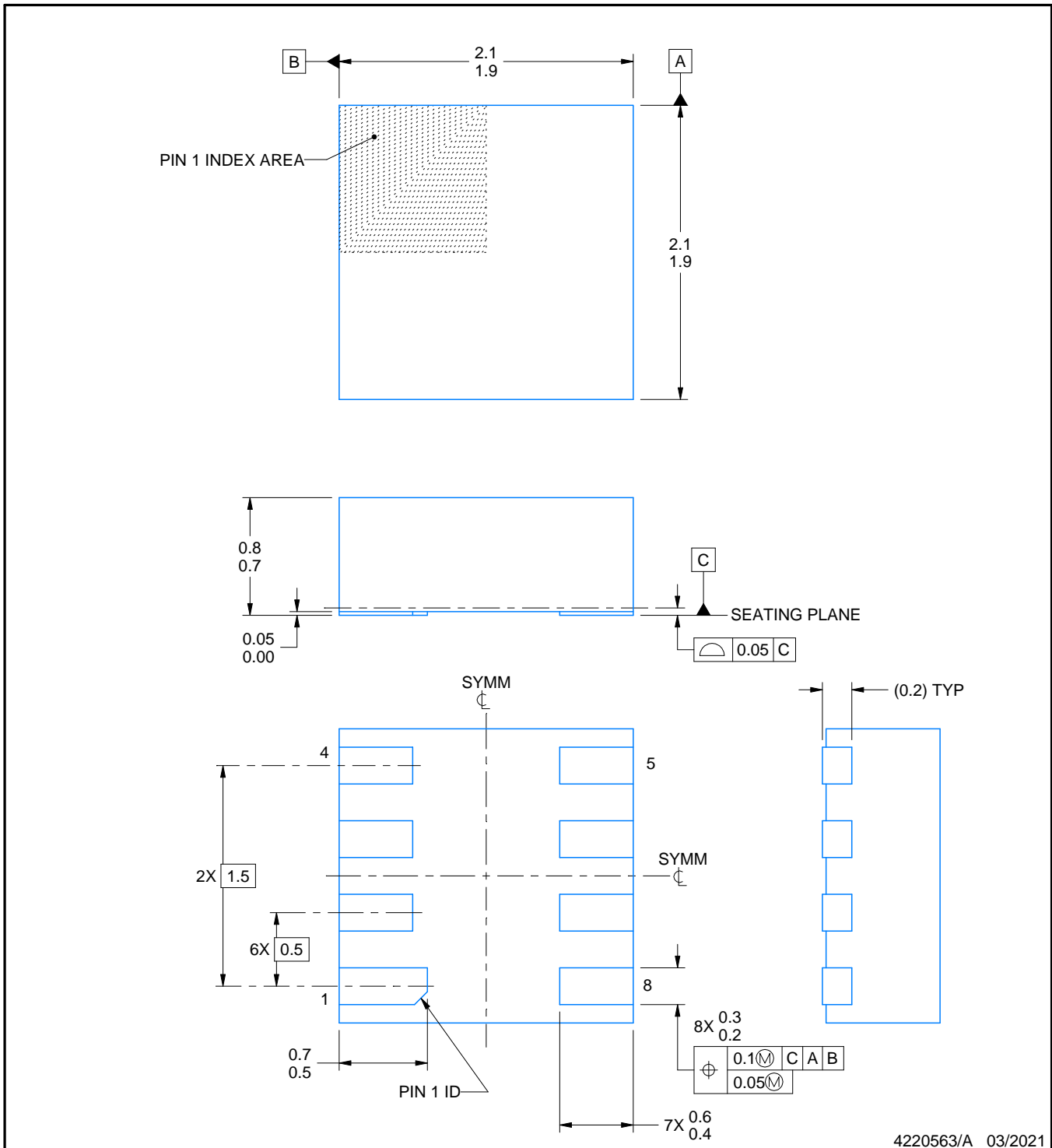
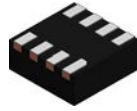

*All dimensions are nominal

| 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 |
|----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LMK1C1102DQFR | WSOP | DQF | 8 | 3000 | 178.0 | 8.4 | 2.25 | 2.25 | 1.0 | 4.0 | 8.0 | Q2 |
| LMK1C1102DQFT | WSOP | DQF | 8 | 250 | 178.0 | 8.4 | 2.25 | 2.25 | 1.0 | 4.0 | 8.0 | Q2 |
| LMK1C1102PWR | TSSOP | PW | 8 | 2000 | 330.0 | 12.4 | 7.0 | 3.6 | 1.6 | 8.0 | 12.0 | Q1 |
| LMK1C1102PWRG4 | TSSOP | PW | 8 | 2000 | 330.0 | 12.4 | 7.0 | 3.6 | 1.6 | 8.0 | 12.0 | Q1 |
| LMK1C1103PWR | TSSOP | PW | 8 | 2000 | 330.0 | 12.4 | 7.0 | 3.6 | 1.6 | 8.0 | 12.0 | Q1 |
| LMK1C1103PWRG4 | TSSOP | PW | 8 | 2000 | 330.0 | 12.4 | 7.0 | 3.6 | 1.6 | 8.0 | 12.0 | Q1 |
| LMK1C1104DQFR | WSOP | DQF | 8 | 3000 | 178.0 | 8.4 | 2.25 | 2.25 | 1.0 | 4.0 | 8.0 | Q2 |
| LMK1C1104DQFT | WSOP | DQF | 8 | 250 | 178.0 | 8.4 | 2.25 | 2.25 | 1.0 | 4.0 | 8.0 | Q2 |
| LMK1C1104PWR | TSSOP | PW | 8 | 2000 | 330.0 | 12.4 | 7.0 | 3.6 | 1.6 | 8.0 | 12.0 | Q1 |
| LMK1C1104PWRG4 | TSSOP | PW | 8 | 2000 | 330.0 | 12.4 | 7.0 | 3.6 | 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) |
|----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LMK1C1102DQFR | WSON | DQF | 8 | 3000 | 205.0 | 200.0 | 33.0 |
| LMK1C1102DQFT | WSON | DQF | 8 | 250 | 205.0 | 200.0 | 33.0 |
| LMK1C1102PWR | TSSOP | PW | 8 | 2000 | 353.0 | 353.0 | 32.0 |
| LMK1C1102PWRG4 | TSSOP | PW | 8 | 2000 | 353.0 | 353.0 | 32.0 |
| LMK1C1103PWR | TSSOP | PW | 8 | 2000 | 353.0 | 353.0 | 32.0 |
| LMK1C1103PWRG4 | TSSOP | PW | 8 | 2000 | 353.0 | 353.0 | 32.0 |
| LMK1C1104DQFR | WSON | DQF | 8 | 3000 | 205.0 | 200.0 | 33.0 |
| LMK1C1104DQFT | WSON | DQF | 8 | 250 | 205.0 | 200.0 | 33.0 |
| LMK1C1104PWR | TSSOP | PW | 8 | 2000 | 353.0 | 353.0 | 32.0 |
| LMK1C1104PWRG4 | TSSOP | PW | 8 | 2000 | 353.0 | 353.0 | 32.0 |



NOTES:

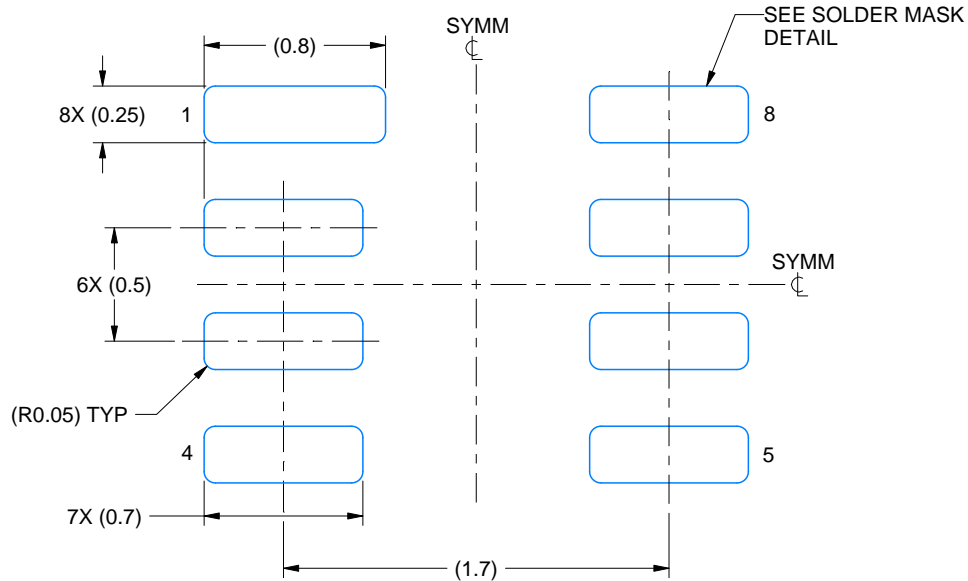
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.

EXAMPLE BOARD LAYOUT

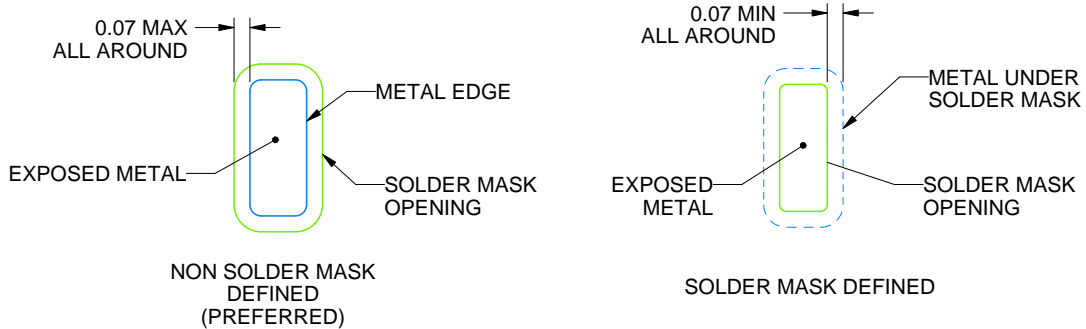
DQF0008A

WSON - 0.8 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 30X



SOLDER MASK DETAILS

4220563/A 03/2021

NOTES: (continued)

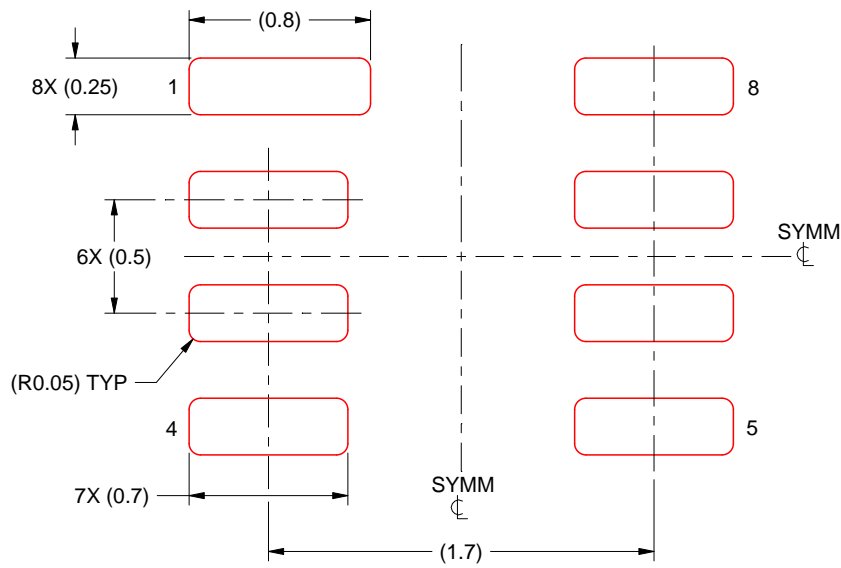
3. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/sluea271).

EXAMPLE STENCIL DESIGN

DQF0008A

WSON - 0.8 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.125 MM THICK STENCIL
SCALE: 30X

4220563/A 03/2021

NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

PW0008A



PACKAGE OUTLINE

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



4221848/A 02/2015

NOTES:

- All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
- This drawing is subject to change without notice.
- 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.
- This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
- Reference JEDEC registration MO-153, variation AA.

EXAMPLE BOARD LAYOUT

PW0008A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
SCALE:10X



SOLDER MASK DETAILS
NOT TO SCALE

4221848/A 02/2015

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

PW0008A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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

4221848/A 02/2015

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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最終更新日：2025 年 10 月