

LMK61XX 高性能超低抖动振荡器

1 特性

- 超低噪声、高性能
 - 抖动: $F_{out} > 100\text{MHz}$ 时的典型值为 90fs RMS
 - PSRR: -70dBc , 强大的电源抗噪性
- 支持的输出格式
 - LVPECL 高达 1 GHz
 - LVDS 高达 900 MHz
 - HSTL 高达 400 MHz
- 总频率容差: $\pm 50\text{ppm}$ (LMK61X2) 和 $\pm 25\text{ppm}$ (LMK61X0)
- 3.3V 工作电压
- 工业温度范围 (-40°C 至 $+85^{\circ}\text{C}$)
- 7mm x 5mm 6 引脚封装, 与行业标准 7050 XO 封装引脚兼容

2 应用

- 晶体振荡器、SAW 振荡器或芯片振荡器的高性能替代产品
- 开关、路由器、网卡、基带装置 (BBU)、服务器、存储/SAN
- 测试和测量
- 医疗成像
- FPGA, 处理器连接

3 说明

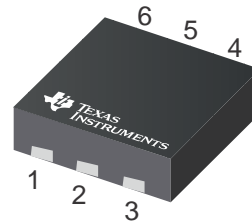
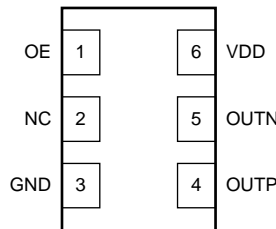
LMK61XX 是一款超低抖动振荡器, 可生成常用的基准时钟。该器件在出厂前进行了预编程, 支持任何基准时钟频率; 支持的输出格式包括 LVPECL (最高 1GHz)、LVDS (最高 900MHz) 和 HCSL (最高 400MHz)。内部电源调节功能提供出色的电源纹波抑制 (PSRR), 降低了供电网络的成本和复杂性。该器件由单个 $3.3\text{V} \pm 5\%$ 电源供电。

器件信息⁽¹⁾

| 器件型号 | 输出频率 (MHz) 及格式 | 总频率稳定性 (PPM) | 封装 |
|----------------|----------------|--------------|--------------------------|
| LMK61A2-100M00 | 100 LVDS | ± 50 | 6 引脚 QFM (7.0mm x 5.0mm) |
| LMK61A2-125M00 | 125 LVDS | ± 50 | |
| LMK61A2-156M25 | 156.25 LVDS | ± 50 | |
| LMK61A2-312M50 | 312.5 LVDS | ± 50 | |
| LMK61A2-644M53 | 644.53125 LVDS | ± 50 | |
| LMK61E0-050M00 | 50 LVPECL | ± 25 | |
| LMK61E0-155M52 | 155.52 LVPECL | ± 25 | |
| LMK61E0-156M25 | 156.25 LVPECL | ± 25 | |
| LMK61E2-100M00 | 100 LVPECL | ± 50 | |
| LMK61E2-125M00 | 125 LVPECL | ± 50 | |
| LMK61E2-156M25 | 156.25 LVPECL | ± 50 | |
| LMK61E2-312M50 | 312.5 LVPECL | ± 50 | |
| LMK61I2-100M00 | 100 HCSL | ± 50 | |

(1) 要了解所有可用封装, 请参阅数据表末尾的可订购产品附录。

引脚分配



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4 修订历史记录

注：之前版本的页码可能与当前版本有所不同。

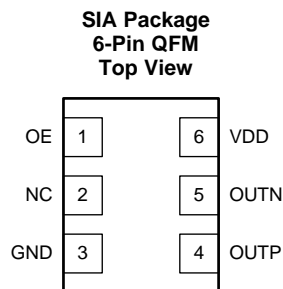
| Changes from Revision C (September 2017) to Revision D | Page |
|--|------|
| • 添加了 LMK61A2-644M | 1 |
| • 添加了 LMK61E0-156M | 1 |

| Changes from Revision B (March 2017) to Revision C | Page |
|--|------|
| • 添加了 LMK61E0-155M | 1 |

| Changes from Revision A (November 2015) to Revision B | Page |
|---|------|
| • 将数据表文本更新为最新的文档和转换标准 | 1 |
| • 添加了 LMK61E0-050M | 1 |
| • 更新了主要图形 | 1 |
| • 添加了接收文档更新通知 部分 | 14 |

| Changes from Original (October 2015) to Revision A | Page |
|--|------|
| • 将“产品预览”更改成了“生产数据数据表” | 1 |

5 Pin Configuration and Functions



Pin Functions

| PIN | | I/O | DESCRIPTION |
|-------------------------------------|------|-----------|--|
| NAME | NO. | | |
| POWER | | | |
| GND | 3 | Ground | Device Ground. |
| VDD | 6 | Analog | 3.3 V Power Supply. |
| OUTPUT BLOCK | | | |
| OUTP, OUTN | 4, 5 | Universal | Differential Output Pair (LVPECL, LVDS or HCSL). |
| DIGITAL CONTROL / INTERFACES | | | |
| NC | 2 | N/A | No Connect. |
| OE | 1 | LVC MOS | Output Enable (internal pullup). When set to low, output pair is disabled and set at high impedance. |

6 Specifications

6.1 Absolute Maximum Ratings

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

| | | MIN | MAX | UNIT |
|------------------|----------------------------------|------|-----------|------|
| VDD | Device supply voltage | -0.3 | 3.6 | V |
| V _{IN} | Output voltage for logic inputs | -0.3 | VDD + 0.3 | V |
| V _{OUT} | Output voltage for clock outputs | -0.3 | VDD + 0.3 | V |
| T _J | Junction temperature | | 150 | °C |
| T _{STG} | Storage temperature | -40 | 125 | °C |

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute maximum-rated conditions for extended periods may affect device reliability.

6.2 ESD Ratings

| | | VALUE | UNIT |
|--------------------|-------------------------|--|-------|
| V _(ESD) | Electrostatic discharge | Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾ | ±4000 |
| | | Charged-device model (CDM), per JEDEC specification JESD22-C101 ⁽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.

6.3 Recommended Operating Conditions

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

| | | MIN | NOM | MAX | UNIT |
|-------------------|------------------------|---------|-----|-------|------|
| VDD | Device supply voltage | 3.135 | 3.3 | 3.465 | V |
| T _A | Ambient temperature | -40 | 25 | 85 | °C |
| T _J | Junction temperature | LMK61X2 | | 125 | °C |
| | | LMK61X0 | | 115 | °C |
| t _{RAMP} | VDD power-up ramp time | 0.1 | | 100 | ms |

6.4 Thermal Information

| THERMAL METRIC ⁽¹⁾ | LMK61XX ^{(2) (3) (4)} | | | UNIT | |
|-------------------------------|--|-------------------|-------------------|------|------|
| | SIA (QFM) | | | | |
| | 6 PINS | | | | |
| | Airflow (LFM) 0 | Airflow (LFM) 200 | Airflow (LFM) 400 | | |
| R _{θJA} | Junction-to-ambient thermal resistance | 55.2 | 46.4 | 43.7 | °C/W |
| R _{θJC(top)} | Junction-to-case (top) thermal resistance | 34.6 | n/a | n/a | °C/W |
| R _{θJB} | Junction-to-board thermal resistance | 37.7 | n/a | n/a | °C/W |
| ψ _{JT} | Junction-to-top characterization parameter | 11.3 | 17.6 | 22.5 | °C/W |
| ψ _{JB} | Junction-to-board characterization parameter | 37.7 | 41.5 | 40.1 | °C/W |
| R _{θJC(bot)} | Junction-to-case (bottom) thermal resistance | n/a | n/a | n/a | °C/W |

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

(2) The package thermal resistance is calculated on a 4 layer JEDEC board.

(3) Connected to GND with 3 thermal vias (0.3-mm diameter).

(4) ψ_{JB} (junction to board) is used when the main heat flow is from the junction to the GND pad. Please refer to Thermal Considerations section for more information on ensuring good system reliability and quality.

6.5 Electrical Characteristics - Power Supply⁽¹⁾

VDD = 3.3 V ± 5%, T_A = -40°C to 85°C

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|-----------|--|-----------------------|-----|-----|-----|------|
| IDD | Device current consumption | LVPECL ⁽²⁾ | | 162 | 208 | mA |
| | | LVDS | | 152 | 196 | |
| | | HCSL | | 155 | 196 | |
| IDD-PD | Device current consumption when output is disabled | OE = GND | | 136 | | mA |

(1) Refer to Parameter Measurement Information for relevant test conditions.

(2) On-chip power dissipation should exclude 40 mW, dissipated in the 150 ohm termination resistors, from total power dissipation.

6.6 LVPECL Output Characteristics⁽¹⁾

VDD = 3.3 V ± 5%, T_A = -40°C to 85°C

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---------------------------------|--|-----------------|-----|----------------------|------|--------|
| f _{OUT} | Output frequency ⁽²⁾ | | 10 | | 1000 | MHz |
| V _{OD} | Output voltage swing (V _{OH} – V _{OL}) ⁽²⁾ | | 700 | 800 | 1200 | mV |
| V _{OUT, DIFF, PP} | Differential output peak-to-peak swing | | | 2 × V _{OD} | | V |
| V _{OS} | Output common-mode voltage | | | VDD – 1.55 | | V |
| t _R / t _F | Output rise/fall time (20% to 80%) ⁽³⁾ | | | 120 | 200 | ps |
| PN-Floor | Output phase noise floor (f _{OFFSET} > 10 MHz) | 156.25 MHz | | –165 | | dBc/Hz |
| ODC | Output duty cycle ⁽³⁾ | | 45% | | 55% | |

(1) Refer to Parameter Measurement Information for relevant test conditions.

(2) An output frequency over f_{OUT} max spec is possible, but output swing may be less than V_{OD} min spec.

(3) Ensured by characterization.

6.7 LVDS Output Characteristics⁽¹⁾

VDD = 3.3 V ± 5%, T_A = –40°C to 85°C

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---------------------------------|--|-----------------|-----|----------------------|-----|--------|
| f _{OUT} | Output frequency ⁽¹⁾ | | 10 | | 900 | MHz |
| V _{OD} | Output voltage swing (V _{OH} – V _{OL}) ⁽¹⁾ | | 300 | 390 | 480 | mV |
| V _{OUT, DIFF, PP} | Differential output peak-to-peak swing | | | 2 × V _{OD} | | V |
| V _{OS} | Output common-mode voltage | | | 1.2 | | V |
| t _R / t _F | Output rise/fall time (20% to 80%) ⁽²⁾ | | | 150 | 250 | ps |
| PN-Floor | Output phase noise floor (f _{OFFSET} > 10 MHz) | 156.25 MHz | | –162 | | dBc/Hz |
| ODC | Output duty cycle ⁽²⁾ | | 45% | | 55% | |
| R _{OUT} | Differential output impedance | | | 125 | | Ohm |

(1) An output frequency over f_{OUT} max spec is possible, but output swing may be less than V_{OD} min spec.

(2) Ensured by characterization.

6.8 HCSL Output Characteristics⁽¹⁾

VDD = 3.3 V ± 5%, T_A = -40°C to 85°C

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--------------------------|--|---------|-----|------|--------|
| f _{OUT} | Output frequency | 10 | | 400 | MHz |
| V _{OH} | Output high voltage | 600 | | 850 | mV |
| V _{OL} | Output low voltage | -100 | | 100 | mV |
| V _{CROSS} | Absolute crossing voltage ⁽²⁾⁽³⁾ | 250 | | 475 | mV |
| V _{CROSS-DELTA} | Variation of V _{CROSS} ⁽²⁾⁽³⁾ | 0 | | 140 | mV |
| dV/dt | Slew rate ⁽⁴⁾ | 0.8 | | 2 | V/ns |
| PN-Floor | Output phase noise floor (f _{OFFSET} > 10 MHz) | 100 MHz | | -164 | dBc/Hz |
| ODC | Output duty cycle ⁽⁴⁾ | 45% | | 55% | |

(1) Refer to Parameter Measurement Information for relevant test conditions.

(2) Measured from -150 mV to +150 mV on the differential waveform with the 300 mVpp measurement window centered on the differential zero crossing.

(3) Ensured by design.

(4) Ensured by characterization.

6.9 OE Input Characteristics

VDD = 3.3 V ± 5%, T_A = -40°C to 85°C

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|-----------------|--------------------|-----------------------|-----|-----|------|
| V _{IH} | Input high voltage | 1.4 | | | V |
| V _{IL} | Input low voltage | | | 0.6 | V |
| I _{IH} | Input high current | V _{IH} = VDD | | 40 | uA |
| I _{IL} | Input low current | V _{IL} = GND | | 40 | uA |
| C _{IN} | Input capacitance | | 2 | | pF |

6.10 Frequency Tolerance Characteristics⁽¹⁾

VDD = 3.3 V ± 5%, T_A = -40°C to 85°C

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT | |
|----------------|---------------------------|--|-----|-----|------|-----|
| f _T | Total frequency tolerance | LMK61X2: All output formats, frequency bands and device junction temperature up to 125°C; includes initial freq tolerance, temperature & supply voltage variation, solder reflow and aging (10 years) | -50 | | 50 | ppm |
| | | LMK61X0: All output formats, frequency bands and device junction temperature up to 115°C; includes initial freq tolerance, temperature & supply voltage variation, solder reflow and aging (5 years at 40°C) | -25 | | 25 | ppm |

(1) Ensured by characterization.

6.11 Power-On/Reset Characteristics (VDD)

VDD = 3.3 V ± 5%, T_A = -40°C to 85°C

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|----------------------|--|--|-----|------|------|
| V _{THRESH} | Threshold voltage ⁽¹⁾ | 2.72 | | 2.95 | V |
| V _{DROOP} | Allowable voltage droop ⁽²⁾ | | | 0.1 | V |
| t _{STARTUP} | Start-up time ⁽¹⁾ | Time elapsed from VDD at 3.135 V to output enabled | | 10 | ms |
| t _{OE-EN} | Output enable time ⁽²⁾ | Time elapsed from OE at V _{IH} to output enabled | | 50 | us |
| t _{OE-DIS} | Output disable time ⁽²⁾ | Time elapsed from OE at V _{IL} to output disabled | | 50 | us |

(1) Ensured by characterization.

(2) Ensured by design.

6.12 PSRR Characteristics⁽¹⁾

VDD = 3.3 V, T_A = 25°C, FS[1:0] = NC, NC

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|-----------|---|----------------------|-----|-----|-----|------|
| PSRR | Spurs induced by 50-mV power supply ripple ⁽²⁾⁽³⁾ at 156.25-MHz output, all output types | Sine wave at 50 kHz | | -70 | | dBc |
| | | Sine wave at 100 kHz | | -70 | | |
| | | Sine wave at 500 kHz | | -70 | | |
| | | Sine wave at 1 MHz | | -70 | | |

(1) Refer to Parameter Measurement Information for relevant test conditions.

(2) Measured max spur level with 50 mVpp sinusoidal signal between 50 kHz and 1 MHz applied on VDD pin

(3) $DJ_{SPUR} (ps, pk-pk) = [2 \cdot 10 \cdot (SPUR/20) / (\pi \cdot f_{OUT})] \cdot 1e6$, where PSRR or SPUR in dBc and f_{OUT} in MHz.

6.13 PLL Clock Output Jitter Characteristics⁽¹⁾⁽²⁾

VDD = 3.3 V ± 5%, T_A = -40°C to 85°C

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|-----------|---|--|-----|-----|-----|--------|
| RJ | RMS phase jitter ⁽³⁾ (12 kHz – 20 MHz) (1 kHz – 5 MHz) | f _{OUT} < 100 MHz, all output types | | 200 | 300 | fs RMS |
| RJ | RMS phase jitter ⁽³⁾ (12 kHz – 20 MHz) (1 kHz – 5 MHz) | f _{OUT} ≥ 100 MHz (except 155.52 MHz and 644.53125 MHz), all output types | | 100 | 200 | fs RMS |
| RJ | RMS phase jitter ⁽³⁾ (12 kHz – 20 MHz) (1 kHz – 5 MHz) | f _{OUT} = 155.52 MHz or 644.53125 MHz, all output types | | 150 | 300 | fs RMS |

(1) Refer to Parameter Measurement Information for relevant test conditions.

(2) Phase jitter measured with Agilent E5052 signal source analyzer using a differential-to-single ended converter (balun or buffer).

(3) Ensured by characterization.

6.14 Typical 156.25-MHz Output Phase Noise Characteristics⁽¹⁾⁽²⁾

VDD = 3.3 V, T_A = 25°C, Output Type = LVPECL/LVDS/HCSL

| PARAMETER | | OUTPUT TYPE | | | UNITS |
|---------------------|-------------------------------|-------------|------|------|--------|
| | | LVPECL | LVDS | HCSL | |
| phn _{10k} | Phase noise at 10-kHz offset | -143 | -143 | -143 | dBc/Hz |
| Phn _{20k} | Phase noise at 20-kHz offset | -143 | -143 | -143 | dBc/Hz |
| phn _{100k} | Phase noise at 100-kHz offset | -144 | -144 | -144 | dBc/Hz |
| Phn _{200k} | Phase noise at 200-kHz offset | -145 | -145 | -145 | dBc/Hz |
| phn _{1M} | Phase noise at 1-MHz offset | -150 | -150 | -150 | dBc/Hz |
| phn _{2M} | Phase noise at 2-MHz offset | -154 | -154 | -154 | dBc/Hz |
| phn _{10M} | Phase noise at 10-MHz offset | -165 | -162 | -164 | dBc/Hz |
| phn _{20M} | Phase noise at 20-MHz offset | -165 | -162 | -164 | dBc/Hz |

(1) Refer to Parameter Measurement Information for relevant test conditions.

(2) Phase jitter measured with Agilent E5052 signal source analyzer using a differential-to-single ended converter (balun or buffer).

6.15 Additional Reliability and Qualification

| PARAMETER | CONDITION / TEST METHOD |
|----------------------------|-------------------------|
| Mechanical Shock | MIL-STD-202, Method 213 |
| Mechanical Vibration | MIL-STD-202, Method 204 |
| Moisture Sensitivity Level | J-STD-020, MSL3 |

6.16 Typical Characteristics

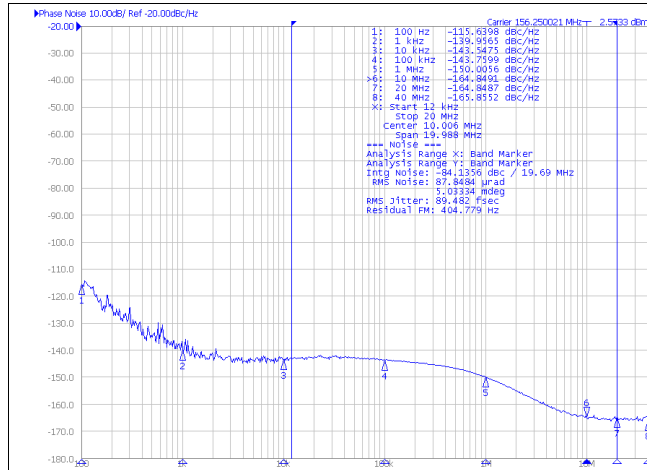


Figure 1. Phase Noise of 156.25-MHz LVPECL Differential Output

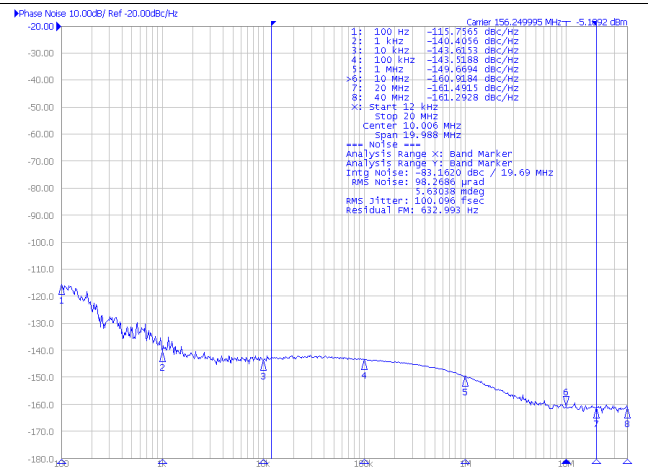


Figure 2. Phase Noise of 156.25-MHz LVDS Differential Output

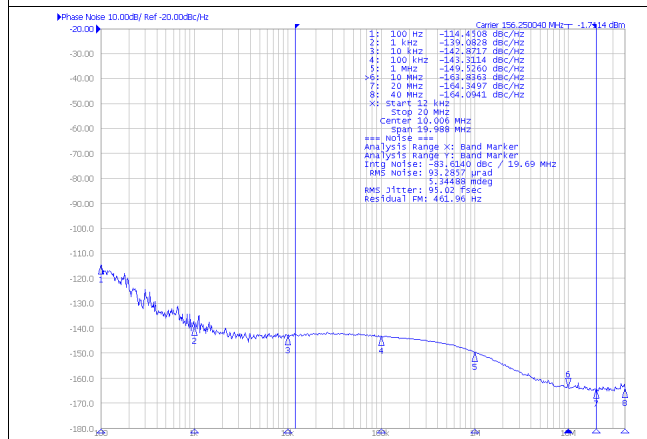


Figure 3. Phase Noise of 156.25-MHz HCSL Differential Output

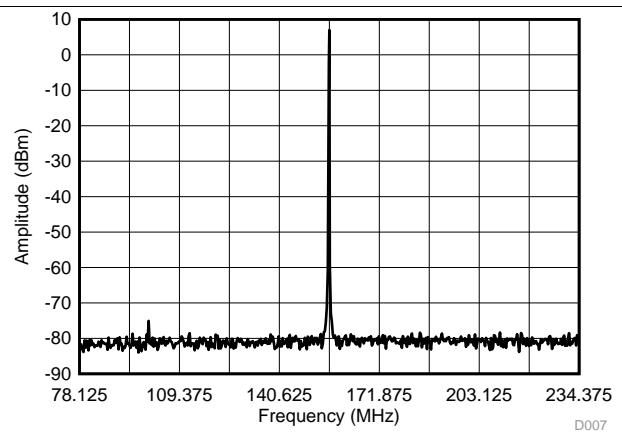


Figure 4. 156.25 ± 78.125-MHz LVPECL Differential Output Spectrum

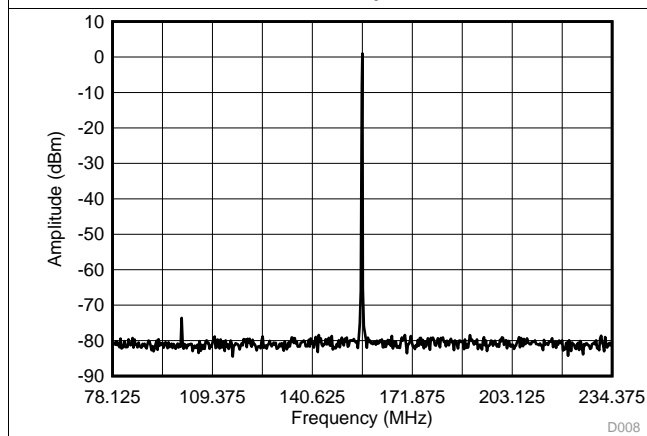


Figure 5. 156.25 ± 78.125-MHz LVDS Differential Output Spectrum

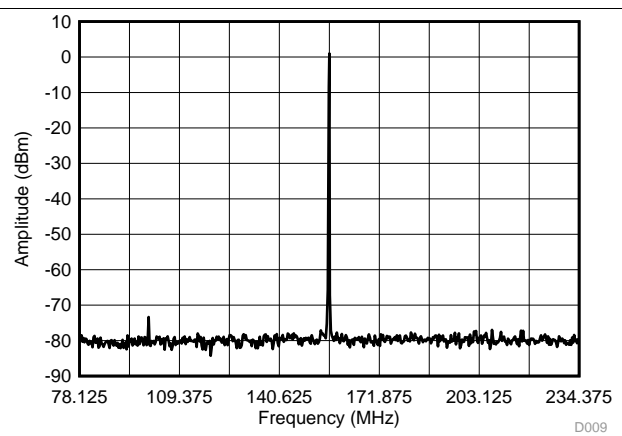


Figure 6. 156.25 ± 78.125-MHz HCSL Differential Output Spectrum

Typical Characteristics (continued)

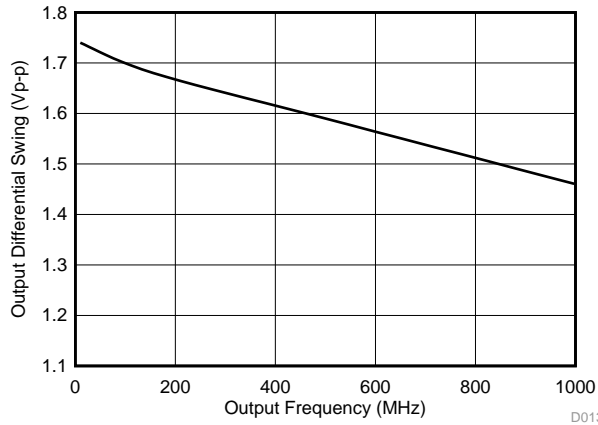


Figure 7. LVPECL Differential Output Swing vs Frequency

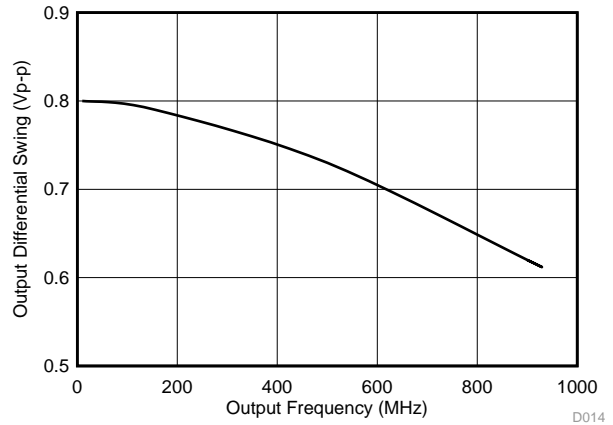


Figure 8. LVDS Differential Output Swing vs Frequency

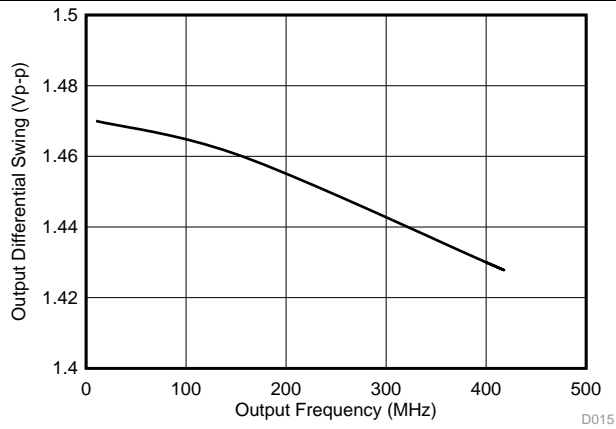


Figure 9. HCSL Differential Output Swing vs Frequency

7 Parameter Measurement Information

7.1 Device Output Configurations

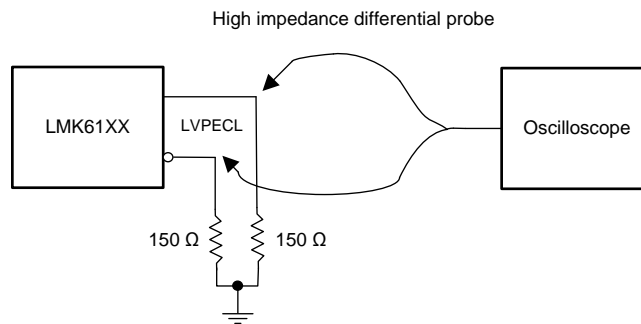


Figure 10. LVPECL Output DC Configuration During Device Test

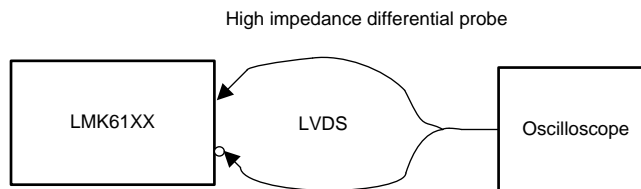


Figure 11. LVDS Output DC Configuration During Device Test

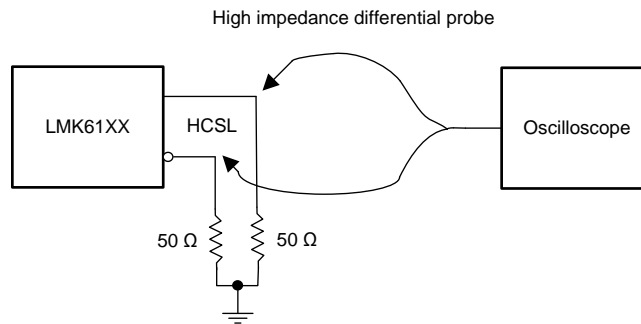


Figure 12. HCSL Output DC Configuration During Device Test

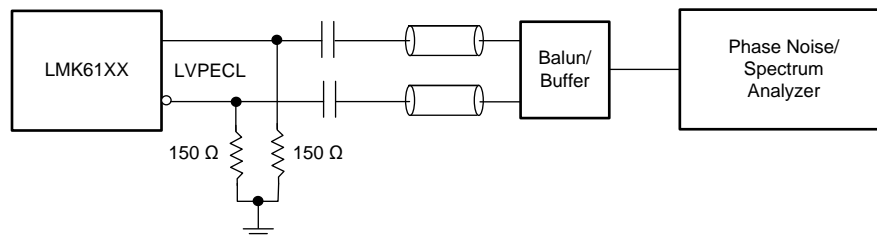


Figure 13. LVPECL Output AC Configuration During Device Test

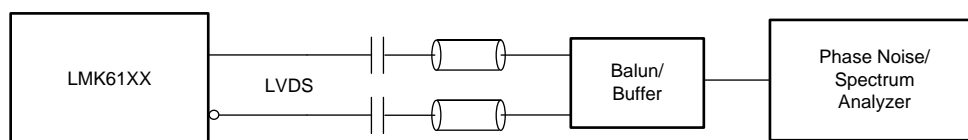


Figure 14. LVDS Output AC Configuration During Device Test

Device Output Configurations (continued)

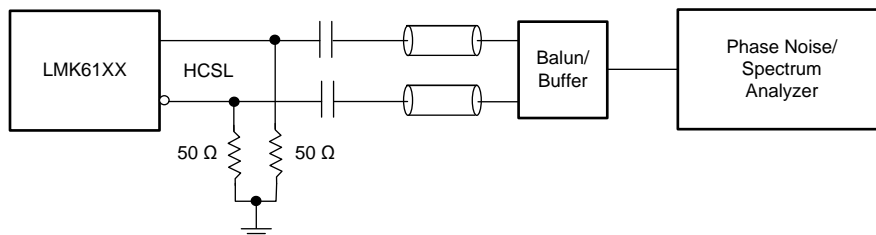


Figure 15. HCSL Output AC Configuration During Device Test

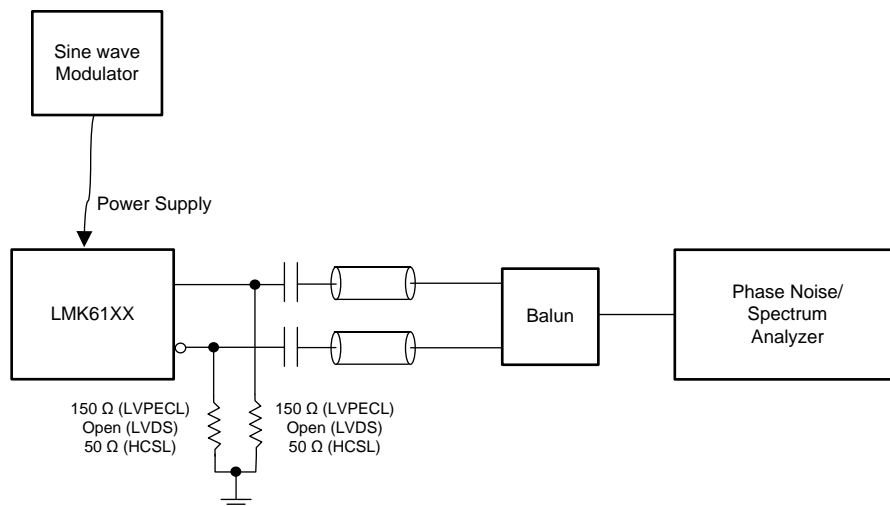


Figure 16. PSRR Test Setup

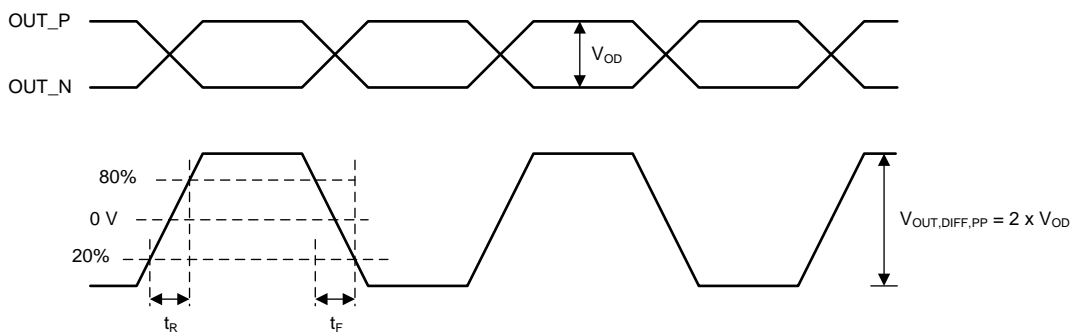


Figure 17. Differential Output Voltage and Rise/Fall Time

8 Power Supply Recommendations

For best electrical performance of LMK61XX, TI recommends using a combination of 10 μF , 1 μF and 0.1 μF on its power supply bypass network. TI also recommends using component side mounting of the power supply bypass capacitors and it is best to use 0201 or 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. [Figure 18](#) shows the layout recommendation for power supply decoupling of LMK61XX.

9 Layout

9.1 Layout Guidelines

The following sections provides recommendations for board layout, solder reflow profile and power supply bypassing when using LMK61XX to ensure good thermal / electrical performance and overall signal integrity of entire system.

9.1.1 Ensuring Thermal Reliability

The LMK61XX is a high performance device. Therefore, pay careful attention to device configuration and printed-circuit board (PCB) layout with respect to power consumption. The ground pin needs to be connected to the ground plane of the PCB through three vias or more, as shown in [Figure 18](#), to maximize thermal dissipation out of the package.

[Equation 1](#) describes the relationship between the PCB temperature around the LMK61XX and its junction temperature.

$$T_B = T_J - \Psi_{JB} \times P$$

where

- T_B : PCB temperature around the LMK61XX
 - T_J : Junction temperature of LMK61XX
 - Ψ_{JB} : Junction-to-board thermal resistance parameter of LMK61XX (37.7°C/W without airflow)
 - P : On-chip power dissipation of LMK61XX
- (1)

To ensure that the maximum junction temperature of LMK61X2 is below 125°C, the maximum PCB temperature without airflow should be at 99°C or below (89°C or below for LMK61X0) when the device is optimized for best performance resulting in maximum on-chip power dissipation of 0.68 W.

9.1.2 Best Practices for Signal Integrity

For best electrical performance and signal integrity of entire system with LMK61XX, TI recommends routing vias into decoupling capacitors and then into the LMK61XX. TI also recommends increasing the via count and width of the traces wherever possible. These steps ensure lowest impedance and shortest path for high frequency current flow. [Figure 18](#) shows the layout recommendation for LMK61XX.

Layout Guidelines (接下页)

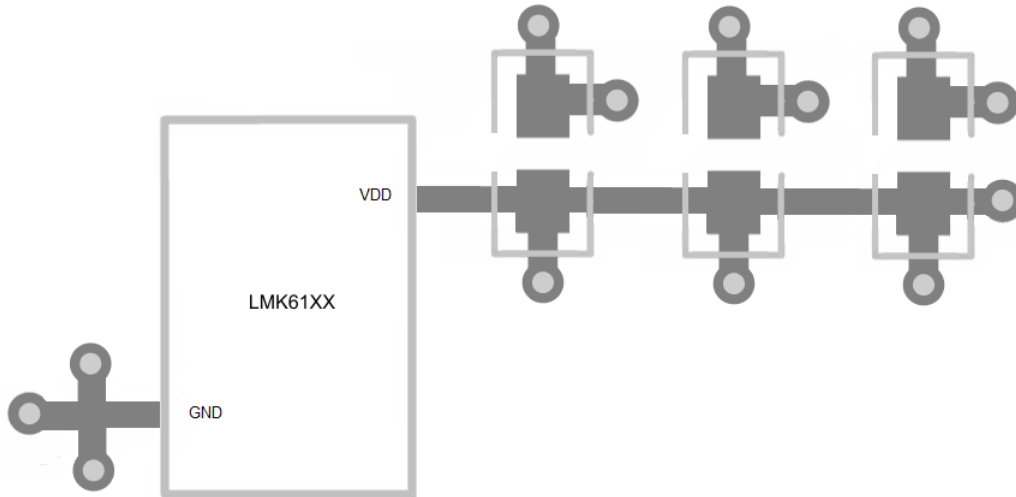


Figure 18. LMK61XX Layout Recommendation for Power Supply and Ground

9.1.3 Recommended Solder Reflow Profile

TI recommends following the solder paste supplier's recommendations to optimize flux activity and to achieve proper melting temperatures of the alloy within the guidelines of J-STD-20. It is preferable for the LMK61XX to be processed with the lowest peak temperature possible while also remaining below the components peak temperature rating as listed on the MSL label. The exact temperature profile would depend on several factors including maximum peak temperature for the component as rated on the MSL label, Board thickness, PCB material type, PCB geometries, component locations, sizes, densities within PCB, as well solder manufactures recommended profile, and capability of the reflow equipment to as confirmed by the SMT assembly operation.

10 器件和文档支持

10.1 相关链接

下表列出了快速访问链接。类别包括技术文档、支持和社区资源、工具和软件以及申请样片或购买产品的快速访问链接。

表 1. 相关链接

| 器件 | 产品文件夹 | 样片与购买 | 技术文档 | 工具和软件 | 支持和社区 |
|--------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| LMK61E0-050M | 请单击此处 | 请单击此处 | 请单击此处 | 请单击此处 | 请单击此处 |
| LMK61E0-155M | 请单击此处 | 请单击此处 | 请单击此处 | 请单击此处 | 请单击此处 |
| LMK61E0-156M | 请单击此处 | 请单击此处 | 请单击此处 | 请单击此处 | 请单击此处 |
| LMK61E2-100M | 请单击此处 | 请单击此处 | 请单击此处 | 请单击此处 | 请单击此处 |
| LMK61E2-125M | 请单击此处 | 请单击此处 | 请单击此处 | 请单击此处 | 请单击此处 |
| LMK61E2-156M | 请单击此处 | 请单击此处 | 请单击此处 | 请单击此处 | 请单击此处 |
| LMK61E2-312M | 请单击此处 | 请单击此处 | 请单击此处 | 请单击此处 | 请单击此处 |
| LMK61A2-100M | 请单击此处 | 请单击此处 | 请单击此处 | 请单击此处 | 请单击此处 |
| LMK61A2-125M | 请单击此处 | 请单击此处 | 请单击此处 | 请单击此处 | 请单击此处 |
| LMK61A2-156M | 请单击此处 | 请单击此处 | 请单击此处 | 请单击此处 | 请单击此处 |
| LMK61A2-312M | 请单击此处 | 请单击此处 | 请单击此处 | 请单击此处 | 请单击此处 |
| LMK61A2-644M | 请单击此处 | 请单击此处 | 请单击此处 | 请单击此处 | 请单击此处 |
| LMK61I2-100M | 请单击此处 | 请单击此处 | 请单击此处 | 请单击此处 | 请单击此处 |

10.2 接收文档更新通知

要接收文档更新通知，请导航至 TI.com 上的器件产品文件夹。单击右上角的 *通知我* 进行注册，即可每周接收产品信息更改摘要。有关更改的详细信息，请查看任何已修订文档中包含的修订历史记录。

10.3 社区资源

下列链接提供到 TI 社区资源的连接。链接的内容由各个分销商“按照原样”提供。这些内容并不构成 TI 技术规范，并且不一定反映 TI 的观点；请参阅 TI 的《使用条款》。

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设计支持 *TI 参考设计支持* 可帮助您快速查找有帮助的 E2E 论坛、设计支持工具以及技术支持的联系信息。

10.4 商标

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 All other trademarks are the property of their respective owners.

10.5 静电放电警告



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

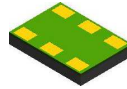
10.6 Glossary

SLYZ022 — *TI Glossary*.

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

11 机械、封装和可订购信息

以下页面包含机械、封装和可订购信息。这些信息是指定器件的最新可用数据。数据如有变更，恕不另行通知和修订此文档。如欲获取此数据表的浏览器版本，请参阅左侧的导航。

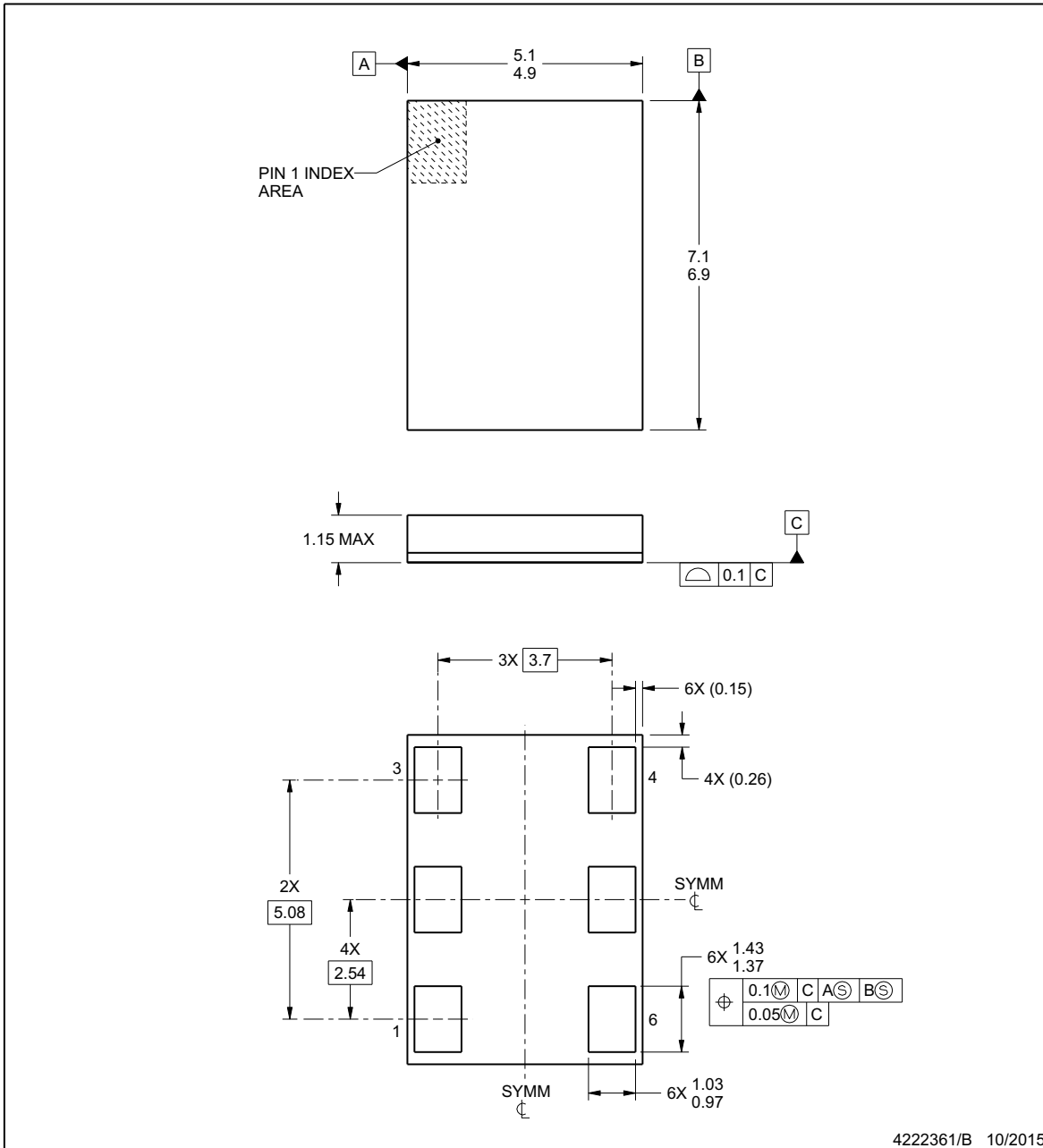


PACKAGE OUTLINE

SIA0006A

QFM - 1.15 mm max height

QUAD FLAT MODULE



NOTES:

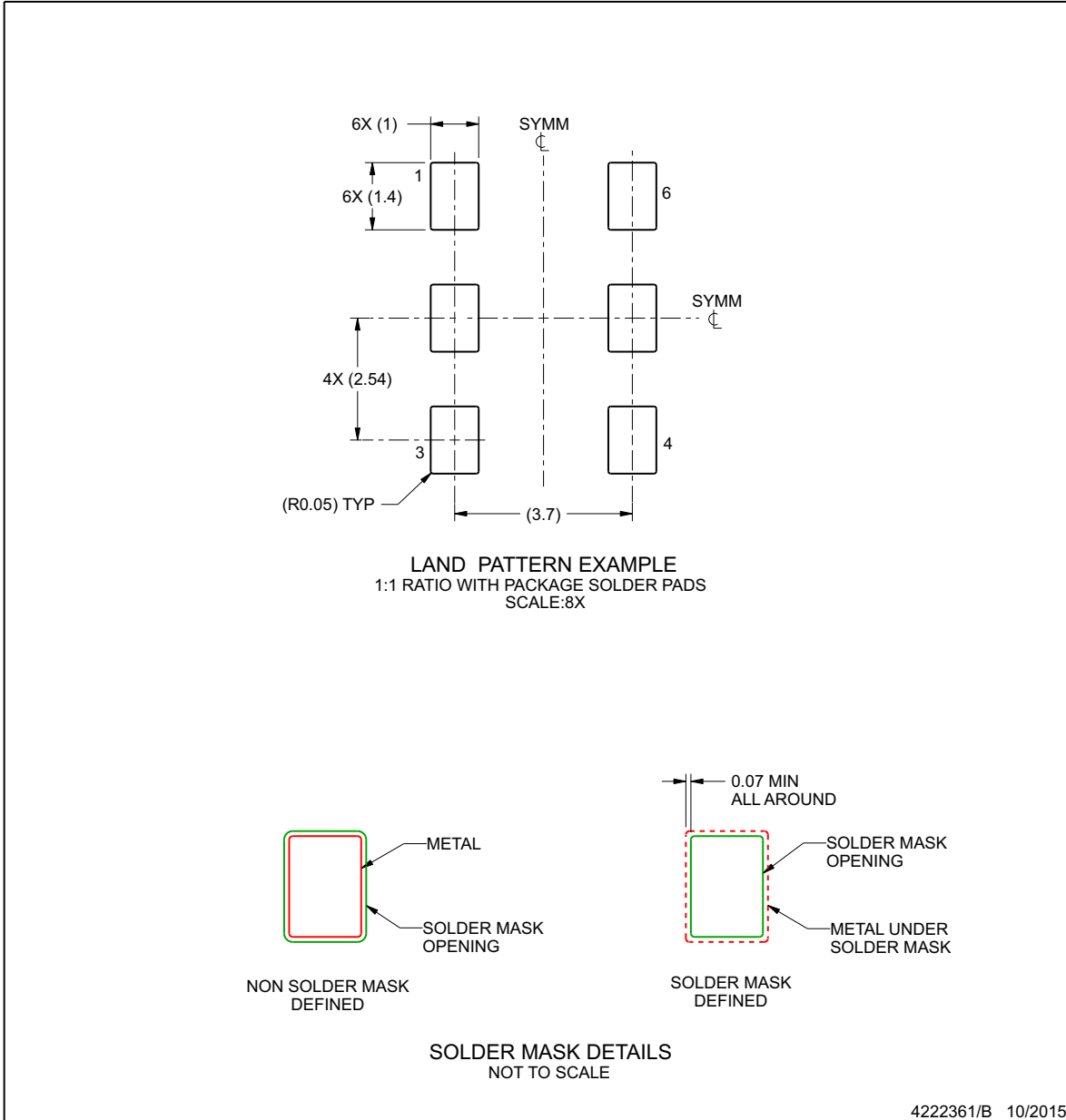
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.

EXAMPLE BOARD LAYOUT

SIA0006A

QFM - 1.15 mm max height

QUAD FLAT MODULE



NOTES: (continued)

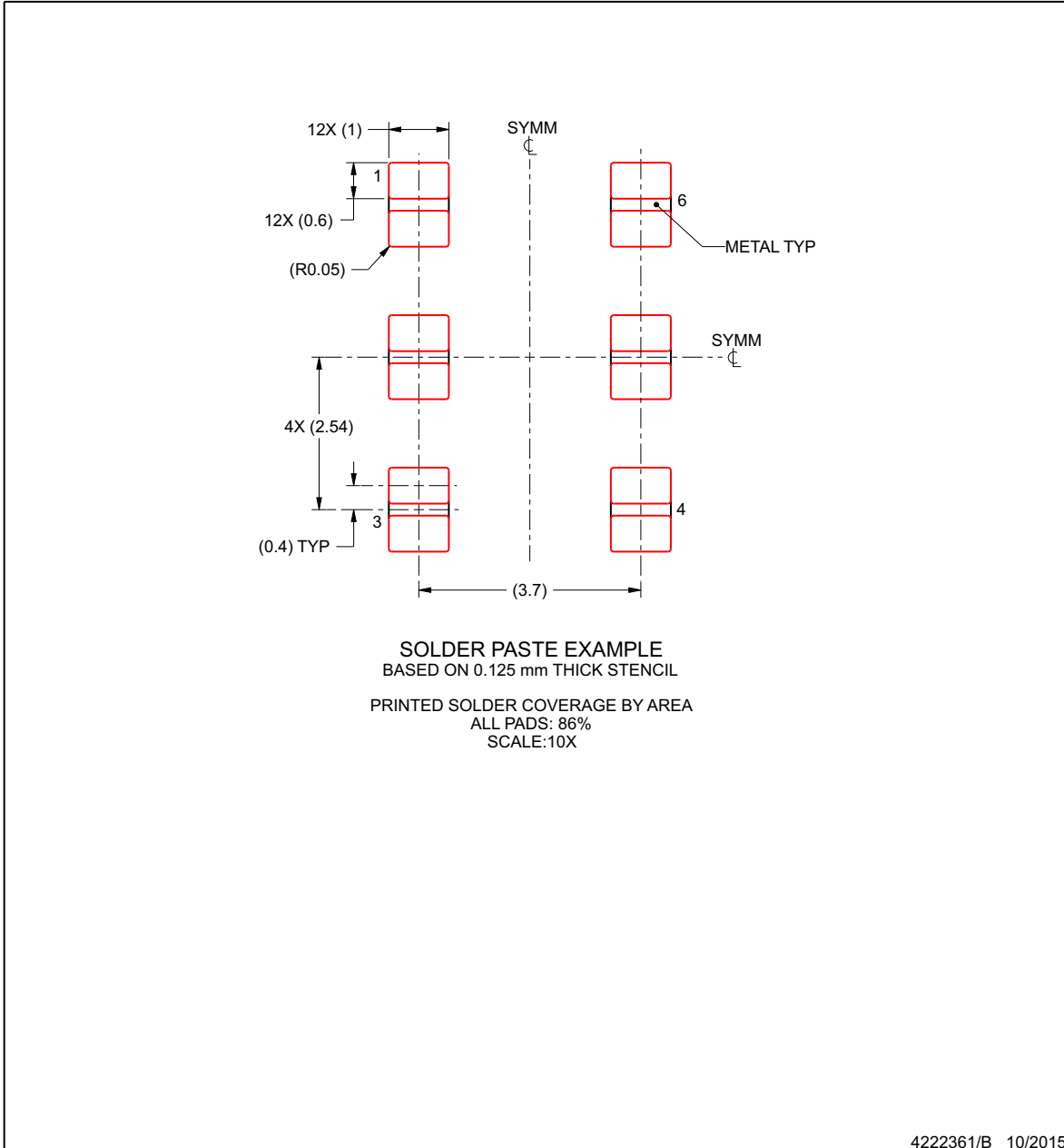
3. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/sluea271).

EXAMPLE STENCIL DESIGN

SIA0006A

QFM - 1.15 mm max height

QUAD FLAT MODULE



NOTES: (continued)

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

PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead finish/ Ball material (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|--------------------|---------------|--------------|-----------------|------|-------------|----------------------------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| LMK61A2-100M00SIAR | ACTIVE | QFM | SIA | 6 | 2500 | RoHS & Green | NIAU | Level-3-260C-168 HR | -40 to 85 | LMK61A2 100M00 | Samples |
| LMK61A2-100M00SIAT | ACTIVE | QFM | SIA | 6 | 250 | RoHS & Green | NIAU | Level-3-260C-168 HR | -40 to 85 | LMK61A2 100M00 | Samples |
| LMK61A2-125M00SIAR | ACTIVE | QFM | SIA | 6 | 2500 | RoHS & Green | NIAU | Level-3-260C-168 HR | -40 to 85 | LMK61A2 125M00 | Samples |
| LMK61A2-125M00SIAT | ACTIVE | QFM | SIA | 6 | 250 | RoHS & Green | NIAU | Level-3-260C-168 HR | -40 to 85 | LMK61A2 125M00 | Samples |
| LMK61A2-156M25SIAR | ACTIVE | QFM | SIA | 6 | 2500 | RoHS & Green | NIAU | Level-3-260C-168 HR | -40 to 85 | LMK61A2 156M25 | Samples |
| LMK61A2-156M25SIAT | ACTIVE | QFM | SIA | 6 | 250 | RoHS & Green | NIAU | Level-3-260C-168 HR | -40 to 85 | LMK61A2 156M25 | Samples |
| LMK61A2-312M50SIAR | ACTIVE | QFM | SIA | 6 | 2500 | RoHS & Green | NIAU | Level-3-260C-168 HR | -40 to 85 | LMK61A2 312M50 | Samples |
| LMK61A2-312M50SIAT | ACTIVE | QFM | SIA | 6 | 250 | RoHS & Green | NIAU | Level-3-260C-168 HR | -40 to 85 | LMK61A2 312M50 | Samples |
| LMK61A2-644M53SIAR | ACTIVE | QFM | SIA | 6 | 2500 | RoHS & Green | NIAU | Level-3-260C-168 HR | -40 to 85 | LMK61A2 644M53 | Samples |
| LMK61A2-644M53SIAT | ACTIVE | QFM | SIA | 6 | 250 | RoHS (In Work) & Green (In Work) | NIAU | Level-3-260C-168 HR | -40 to 85 | LMK61A2 644M53 | Samples |
| LMK61E0-050M00SIAR | ACTIVE | QFM | SIA | 6 | 2500 | RoHS & Green | NIAU | Level-3-260C-168 HR | -40 to 85 | LMK61E0 050M00 | Samples |
| LMK61E0-050M00SIAT | ACTIVE | QFM | SIA | 6 | 250 | RoHS & Green | NIAU | Level-3-260C-168 HR | -40 to 85 | LMK61E0 050M00 | Samples |
| LMK61E0-155M52SIAR | ACTIVE | QFM | SIA | 6 | 2500 | RoHS & Green | NIAU | Level-3-260C-168 HR | -40 to 85 | LMK61E0 155M52 | Samples |
| LMK61E0-155M52SIAT | ACTIVE | QFM | SIA | 6 | 250 | RoHS & Green | NIAU | Level-3-260C-168 HR | -40 to 85 | LMK61E0 155M52 | Samples |
| LMK61E0-156M25SIAR | ACTIVE | QFM | SIA | 6 | 2500 | RoHS & Green | NIAU | Level-3-260C-168 HR | -40 to 85 | LMK61E0 156M25 | Samples |
| LMK61E0-156M25SIAT | ACTIVE | QFM | SIA | 6 | 250 | RoHS & Green | NIAU | Level-3-260C-168 HR | -40 to 85 | LMK61E0 156M25 | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead finish/ Ball material (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|--------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| LMK61E2-100M00SIAR | ACTIVE | QFM | SIA | 6 | 2500 | RoHS & Green | NIAU | Level-3-260C-168 HR | -40 to 85 | LMK61E2 100M00 | Samples |
| LMK61E2-100M00SIAT | ACTIVE | QFM | SIA | 6 | 250 | RoHS & Green | NIAU | Level-3-260C-168 HR | -40 to 85 | LMK61E2 100M00 | Samples |
| LMK61E2-125M00SIAR | ACTIVE | QFM | SIA | 6 | 2500 | RoHS & Green | NIAU | Level-3-260C-168 HR | -40 to 85 | LMK61E2 125M00 | Samples |
| LMK61E2-125M00SIAT | ACTIVE | QFM | SIA | 6 | 250 | RoHS & Green | NIAU | Level-3-260C-168 HR | -40 to 85 | LMK61E2 125M00 | Samples |
| LMK61E2-156M25SIAR | ACTIVE | QFM | SIA | 6 | 2500 | RoHS & Green | NIAU | Level-3-260C-168 HR | -40 to 85 | LMK61E2 156M25 | Samples |
| LMK61E2-156M25SIAT | ACTIVE | QFM | SIA | 6 | 250 | RoHS & Green | NIAU | Level-3-260C-168 HR | -40 to 85 | LMK61E2 156M25 | Samples |
| LMK61E2-312M50SIAR | ACTIVE | QFM | SIA | 6 | 2500 | RoHS & Green | NIAU | Level-3-260C-168 HR | -40 to 85 | LMK61E2 312M50 | Samples |
| LMK61E2-312M50SIAT | ACTIVE | QFM | SIA | 6 | 250 | RoHS & Green | NIAU | Level-3-260C-168 HR | -40 to 85 | LMK61E2 312M50 | Samples |
| LMK61I2-100M00SIAR | ACTIVE | QFM | SIA | 6 | 2500 | RoHS & Green | NIAU | Level-3-260C-168 HR | -40 to 85 | LMK61I2 100M00 | Samples |
| LMK61I2-100M00SIAT | ACTIVE | QFM | SIA | 6 | 250 | RoHS & Green | NIAU | Level-3-260C-168 HR | -40 to 85 | LMK61I2 100M00 | Samples |

(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.

OBSELETE: 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 <=1000ppm 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.
- (6) Lead finish/Ball material - Orderable Devices 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.

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