

## LP324 LP2902 超低功耗四路运算放大器

### 1 特性

- 低电源电流：85  $\mu\text{A}$  (典型值)
- 低失调电压：2mV (典型值)
- 低输入偏置电流：2nA (典型值)
- 输入共模至地
- 宽电源电压：3V <  $V_{\text{CC}}$  < 32V
- 与 LM324 引脚兼容

### 2 应用

- LCD 显示屏
- 便携式仪表
- 传感器和计量设备
- 消费类电子产品：
  - MP3 播放器、玩具等
- 电源

### 3 说明

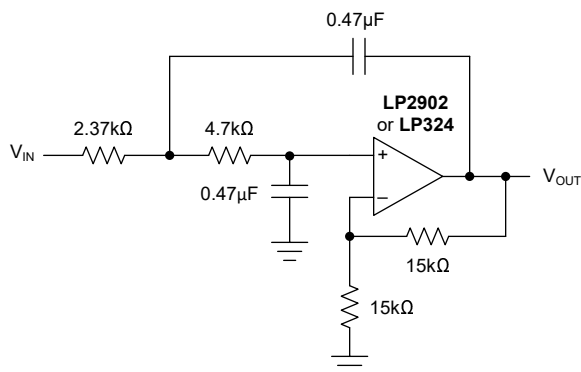
LP324 和 LP2902 是四通道低功耗运算放大器，专为电池供电应用而设计。尽管电源电流超低，但仍可实现良好的输入规格和宽电源电压范围。通过包括接地 (GND) 在内的输入共模范围，实现单个电源操作。

在宽电源电压和低功耗比速度和带宽更重要的应用中，LP324 和 LP2902 是理想选择。这些应用包括便携式仪表、LCD 显示屏、消费类电子产品 (MP3 播放器，玩具等) 及电源。

#### 器件信息

| 器件型号   | 温度 ( $T_A$ )  | 封装 <sup>(1)</sup>                              |
|--------|---------------|------------------------------------------------|
| LP2902 | -40°C 至 +85°C | D (SOIC, 14)<br>N (PDIP, 14)<br>PW (TSSOP, 14) |
| LP324  | 0°C 至 70°C    |                                                |

(1) 有关所有可用封装，请参阅 节 8。



增益为 2 的 100Hz 低通滤波器



内容

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4 引脚配置和功能

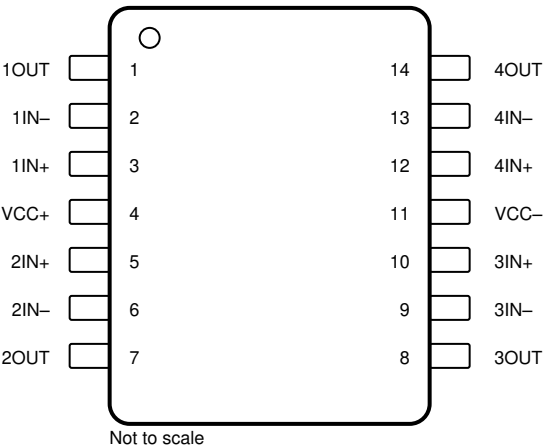


图 4-1. D 封装，14 引脚 SOIC；N 封装，14 引脚 PDIP；PW 封装，14 引脚 TSSOP（顶视图）

表 4-1. 引脚功能

| 引脚    |    | 类型 | 说明                  |
|-------|----|----|---------------------|
| 名称    | 编号 |    |                     |
| 1IN - | 2  | 输入 | 负输入                 |
| 1IN+  | 3  | 输入 | 正输入                 |
| 1OUT  | 1  | 输出 | 输出                  |
| 2IN - | 6  | 输入 | 负输入                 |
| 2IN+  | 5  | 输入 | 正输入                 |
| 2OUT  | 7  | 输出 | 输出                  |
| 3IN - | 9  | 输入 | 负输入                 |
| 3IN+  | 10 | 输入 | 正输入                 |
| 3OUT  | 8  | 输出 | 输出                  |
| 4IN - | 13 | 输入 | 负输入                 |
| 4IN+  | 12 | 输入 | 正输入                 |
| 4OUT  | 14 | 输出 | 输出                  |
| VCC - | 11 | 电源 | 负（最低）电源或接地（对于单电源供电） |
| VCC+  | 4  | 电源 | 正（最高）电源             |

## 5 规格

### 5.1 绝对最大额定值

在自然通风条件下的工作温度范围内测得 (除非另有说明) (1) (2)

|                  |                                                                                 |     | 最小值  | 最大值 | 单位 |
|------------------|---------------------------------------------------------------------------------|-----|------|-----|----|
| V <sub>CC</sub>  | 电源电压                                                                            | 单电源 |      | 32  | V  |
|                  |                                                                                 | 双电源 |      | ±16 |    |
| V <sub>ID</sub>  | 差动输入电压(3)                                                                       |     |      | 32  | V  |
| V <sub>I</sub>   | 输入电压 (任一输入)                                                                     |     | -0.3 | 32  | V  |
|                  | 输出短路接地 (单个放大器) 的持续时间 (测试条件:<br>T <sub>A</sub> ≤ 25°C, V <sub>CC</sub> ≤ 15V(4)) |     | 无限   |     |    |
| T <sub>J</sub>   | 工作虚拟结温                                                                          |     |      | 150 | °C |
| T <sub>stg</sub> | 贮存温度                                                                            |     | -65  | 150 | °C |

- (1) 在绝对最大额定值范围外运行可能对器件造成永久损坏。绝对最大额定值并不表示器件在这些条件下或在建议的工作条件以外的任何其他条件下能够正常运行。如果在建议运行条件之外但在绝对最大额定值范围内使用, 器件可能不会完全正常运行, 这可能会影响器件的可靠性、功能性和性能, 并缩短器件的寿命。
- (2) 所有电压值 (差动电压和为 I<sub>OS</sub> 测量指定的 V<sub>CC</sub> 除外) 都是相对于网络接地 (GND) 的值。
- (3) 差动电压是相对于 IN- 的 IN+ 上的值。
- (4) 从输出到 V<sub>CC</sub> 的短路会导致过热, 并且最终会发生损坏。

### 5.2 ESD 等级

|                    |      |                                            | 值    | 单位 |
|--------------------|------|--------------------------------------------|------|----|
| V <sub>(ESD)</sub> | 静电放电 | 人体放电模式 (HBM), 符合 ANSI/ESDA/JEDEC JS-001 标准 | ±350 | V  |

### 5.3 建议运行条件

在自然通风条件下的工作温度范围内测得 (除非另有说明)

|                |        |        | 最小值 | 标称值 | 最大值 | 单位 |
|----------------|--------|--------|-----|-----|-----|----|
| T <sub>A</sub> | 工作环境温度 | LP2902 | -40 |     | 85  | °C |
|                |        | LP324  | 0   |     | 70  |    |

### 5.4 热性能信息

| 热指标(1) (2)       |        | LP2902、LP324 |            |          | 单位   |
|------------------|--------|--------------|------------|----------|------|
|                  |        | D (SOIC)     | PW (TSSOP) | N (PDIP) |      |
|                  |        | 14 引脚        | 14 引脚      | 14 引脚    |      |
| R <sub>θJA</sub> | 结至环境热阻 | 140          | 154        | 90       | °C/W |

- (1) 有关新旧热指标的更多信息, 请参阅 [半导体和 IC 封装热指标](#) 应用报告。
- (2) 最大功耗是与 T<sub>J(max)</sub>、θ<sub>JA</sub> 和 T<sub>A</sub> 相关的函数。在任何允许的环境温度下, 允许的最大功率耗散为 P<sub>D</sub> = (T<sub>J(max)</sub> - T<sub>A</sub>) / θ<sub>JA</sub>。在 150°C 的绝对最大 T<sub>J</sub> 下, 运行可能会影响可靠性。

## 5.5 电气特性

在  $T_A = 25^\circ\text{C}$ 、 $V_{CC} = 5\text{V}$ 、 $V_{IC} = V_{CC} / 2$  且  $R_L = 100\text{k}\Omega$  连接至 GND 条件下 (除非另有说明)

| 参数                   |          | 测试条件                                                                  |                                           | 最小值                      |     | 典型值 |        | 最大值 |  | 单位 |  |
|----------------------|----------|-----------------------------------------------------------------------|-------------------------------------------|--------------------------|-----|-----|--------|-----|--|----|--|
| 失调电压                 |          |                                                                       |                                           |                          |     |     |        |     |  |    |  |
| V <sub>IO</sub>      | 输入偏移电压   | LP2902                                                                |                                           | 2                        |     | 4   |        | mV  |  |    |  |
|                      |          |                                                                       | T <sub>A</sub> = -40°C 至 +85°C            | 10                       |     |     |        |     |  |    |  |
|                      |          | LP324                                                                 |                                           | 2                        |     | 4   |        |     |  |    |  |
|                      |          |                                                                       | T <sub>A</sub> = 0°C 至 70°C               | 9                        |     |     |        |     |  |    |  |
| dV <sub>IO</sub> /dT | 输入失调电压漂移 | LP2902 , T <sub>A</sub> = 0°C 至 70°C                                  |                                           |                          | 10  |     | μ V/°C |     |  |    |  |
|                      |          | LP324 , T <sub>A</sub> = - 40°C 至 +85°C                               |                                           |                          | 10  |     |        |     |  |    |  |
| PSRR                 | 电源抑制比    | V <sub>CC</sub> = 5V 至 30V                                            |                                           | 80                       | 90  |     | dB     |     |  |    |  |
|                      |          |                                                                       | LP2902<br>T <sub>A</sub> = - 40°C 至 +85°C | 75                       |     |     |        |     |  |    |  |
|                      |          |                                                                       | LP324<br>T <sub>A</sub> = 0°C 至 70°C      | 75                       |     |     |        |     |  |    |  |
| CMRR                 | 共模抑制比    | V <sub>CC</sub> = 30V , V <sub>IC</sub> = 0V 至 V <sub>CC</sub> - 1.5V |                                           | 80                       | 90  |     | dB     |     |  |    |  |
|                      |          |                                                                       | LP2902<br>T <sub>A</sub> = - 40°C 至 +85°C | 75                       |     |     |        |     |  |    |  |
|                      |          |                                                                       | LP324<br>T <sub>A</sub> = 0°C 至 70°C      | 75                       |     |     |        |     |  |    |  |
| 输入偏置电流               |          |                                                                       |                                           |                          |     |     |        |     |  |    |  |
| I <sub>IB</sub>      | 输入偏置电流   | LP2902                                                                |                                           | 2                        |     | 20  |        | nA  |  |    |  |
|                      |          |                                                                       | T <sub>A</sub> = -40°C 至 +85°C            | 40                       |     |     |        |     |  |    |  |
|                      |          | LP324                                                                 |                                           | 2                        |     | 10  |        |     |  |    |  |
|                      |          |                                                                       | T <sub>A</sub> = 0°C 至 70°C               | 20                       |     |     |        |     |  |    |  |
| I <sub>IO</sub>      | 输入失调电流   | LP2902                                                                |                                           | 0.5                      |     | 4   |        | nA  |  |    |  |
|                      |          |                                                                       | T <sub>A</sub> = -40°C 至 +85°C            | 8                        |     |     |        |     |  |    |  |
|                      |          | LP324                                                                 |                                           | 0.2                      |     | 2   |        |     |  |    |  |
|                      |          |                                                                       | T <sub>A</sub> = 0°C 至 70°C               | 4                        |     |     |        |     |  |    |  |
| I <sub>IO</sub> /dT  | 输入失调电流漂移 | LP2902                                                                |                                           |                          | 10  |     | pA/°C  |     |  |    |  |
|                      |          | LP324                                                                 |                                           |                          | 10  |     |        |     |  |    |  |
| 开环增益                 |          |                                                                       |                                           |                          |     |     |        |     |  |    |  |
| A <sub>V</sub>       | 大信号电压增益  | V <sub>CC</sub> = 30V , R <sub>L</sub> = 10kΩ 至 GND                   | LP2902                                    | 40                       | 70  |     | V/mV   |     |  |    |  |
|                      |          |                                                                       | LP2902<br>T <sub>A</sub> = - 40°C 至 +85°C | 30                       |     |     |        |     |  |    |  |
|                      |          |                                                                       | LP324                                     | 50                       | 100 |     |        |     |  |    |  |
|                      |          |                                                                       | LP324<br>T <sub>A</sub> = 0°C 至 70°C      | 40                       |     |     |        |     |  |    |  |
| 频率响应                 |          |                                                                       |                                           |                          |     |     |        |     |  |    |  |
| GBW                  | 增益带宽积    | V <sub>CC</sub> = ±15V                                                |                                           |                          | 100 |     | kHz    |     |  |    |  |
| SR                   | 压摆率      | V <sub>CC</sub> = ±15V                                                |                                           |                          | 50  |     | V/ms   |     |  |    |  |
| 输出                   |          |                                                                       |                                           |                          |     |     |        |     |  |    |  |
| V <sub>O</sub>       | 输出电压摆幅   | I <sub>L</sub> = 350μA 接地 , V <sub>IC</sub> = 0V                      |                                           | 3.4                      | 3.6 |     | V      |     |  |    |  |
|                      |          |                                                                       | LP2902<br>T <sub>A</sub> = - 40°C 至 +85°C | (V <sub>CC</sub> ) - 1.9 |     |     |        |     |  |    |  |
|                      |          |                                                                       | LP324<br>T <sub>A</sub> = 0°C 至 70°C      | (V <sub>CC</sub> ) - 1.9 |     |     |        |     |  |    |  |
|                      |          | I <sub>L</sub> = 350μA 至 V <sub>CC</sub> , V <sub>IC</sub> = 0V       |                                           | 0.82                     | 0.7 |     |        |     |  |    |  |
|                      |          |                                                                       | LP2902<br>T <sub>A</sub> = - 40°C 至 +85°C | 1                        |     |     |        |     |  |    |  |
|                      |          |                                                                       | LP324<br>T <sub>A</sub> = 0°C 至 70°C      | 1                        |     |     |        |     |  |    |  |

## 5.5 电气特性 (续)

在  $T_A = 25^\circ\text{C}$ 、 $V_{CC} = 5\text{V}$ 、 $V_{IC} = V_{CC} / 2$  且  $R_L = 100\text{k}\Omega$  连接至 GND 条件下 (除非另有说明)

| 参数              |      | 测试条件                                                                      |                                           | 最小值 | 典型值 | 最大值 | 单位 |
|-----------------|------|---------------------------------------------------------------------------|-------------------------------------------|-----|-----|-----|----|
| I <sub>O</sub>  | 输出电流 | 拉电流，V <sub>O</sub> = 3V，V <sub>ID</sub> = 1V                              |                                           | 7   | 10  | mA  |    |
|                 |      |                                                                           | LP2902<br>T <sub>A</sub> = - 40°C 至 +85°C | 4   |     |     |    |
|                 |      |                                                                           | LP324<br>T <sub>A</sub> = 0°C 至 70°C      | 4   |     |     |    |
|                 |      | 灌电流，V <sub>O</sub> = 1.5V，V <sub>ID</sub> = - 1V                          |                                           | 4   | 5   |     |    |
|                 |      |                                                                           | LP2902<br>T <sub>A</sub> = - 40°C 至 +85°C | 3   |     |     |    |
|                 |      |                                                                           | LP324<br>T <sub>A</sub> = 0°C 至 70°C      | 3   |     |     |    |
|                 |      | 灌电流，V <sub>O</sub> = 1.5V，V <sub>ID</sub> = - 1V，<br>V <sub>IC</sub> = 0V |                                           | 2   | 4   |     |    |
|                 |      |                                                                           | LP2902<br>T <sub>A</sub> = - 40°C 至 +85°C | 1   |     |     |    |
|                 |      |                                                                           | LP324<br>T <sub>A</sub> = 0°C 至 70°C      | 1   |     |     |    |
| I <sub>sc</sub> | 短路电流 | 短接至地，V <sub>ID</sub> = 1V                                                 |                                           |     | 20  | 35  | mA |
|                 |      |                                                                           | LP2902<br>T <sub>A</sub> = - 40°C 至 +85°C |     |     | 40  |    |
|                 |      |                                                                           | LP324<br>T <sub>A</sub> = 0°C 至 70°C      |     |     | 40  |    |
|                 |      | 短接至 V <sub>CC</sub> ，V <sub>ID</sub> = - 1V                               |                                           |     | 15  | 30  |    |
|                 |      |                                                                           | LP2902<br>T <sub>A</sub> = - 40°C 至 +85°C |     |     | 45  |    |
|                 |      |                                                                           | LP324<br>T <sub>A</sub> = 0°C 至 70°C      |     |     | 45  |    |
|                 | 电源   |                                                                           |                                           |     |     |     |    |
| I <sub>CC</sub> | 电源电流 | 无负载                                                                       |                                           |     | 85  | 150 | μA |
|                 |      |                                                                           | LP2902<br>T <sub>A</sub> = - 40°C 至 +85°C |     |     | 275 |    |
|                 |      |                                                                           | LP324<br>T <sub>A</sub> = 0°C 至 70°C      |     |     | 250 |    |

## 6 器件和文档支持

TI 提供广泛的开发工具。下面列出了用于评估器件性能、生成代码和开发解决方案的工具和软件。

### 6.1 接收文档更新通知

要接收文档更新通知，请导航至 [ti.com](http://ti.com) 上的器件产品文件夹。点击 [通知](#) 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。

### 6.2 支持资源

**TI E2E™ 中文支持论坛** 是工程师的重要参考资料，可直接从专家处获得快速、经过验证的解答和设计帮助。搜索现有解答或提出自己的问题，获得所需的快速设计帮助。

链接的内容由各个贡献者“按原样”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](#)。

### 6.3 商标

TI E2E™ is a trademark of Texas Instruments.

所有商标均为其各自所有者的财产。

### 6.4 静电放电警告



静电放电 (ESD) 会损坏这个集成电路。德州仪器 (TI) 建议通过适当的预防措施处理所有集成电路。如果不遵守正确的处理和安装程序，可能会损坏集成电路。

ESD 的损坏小至导致微小的性能降级，大至整个器件故障。精密的集成电路可能更容易受到损坏，这是因为非常细微的参数更改都可能会导致器件与其发布的规格不相符。

### 6.5 术语表

**TI 术语表**      本术语表列出并解释了术语、首字母缩略词和定义。

## 7 修订历史记录

注：以前版本的页码可能与当前版本的页码不同

| Changes from Revision A (May 2005) to Revision B (September 2025)         | Page |
|---------------------------------------------------------------------------|------|
| • 更新了整个文档中的表格、图和交叉参考的编号格式.....                                            | 1    |
| • 添加了 <i>引脚配置和功能、规格、建议运行条件、器件和文档支持</i> 以及 <i>机械、封装和可订购信息</i> 部分.....      | 1    |
| • 更新了首页图示.....                                                            | 1    |
| • 删除了 <i>原理图 (每个放大器)</i> 图示.....                                          | 2    |
| • 删除了 <i>绝对最大额定值</i> 中的注释 6.....                                          | 3    |
| • 将封装热阻抗信息从 <i>绝对最大额定值</i> 移到了 <i>热性能信息</i> .....                         | 3    |
| • 将 <i>ESD</i> 等级中的人体放电模式值从 $\pm 2\text{kV}$ 更改为了 $\pm 350\text{V}$ ..... | 3    |
| • 添加了 <i>热性能信息</i> 并更新了值.....                                             | 3    |
| • 删除了注释 1、2 和 3.....                                                      | 4    |
| • 将电源抑制比单位从 V 更改为了 dB (拼写错误) .....                                        | 4    |

## 8 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可用的最新数据。数据如有变更，恕不另行通知，且不会对此文档进行修订。有关此数据表的浏览器版本，请查阅左侧的导航栏。

## PACKAGING INFORMATION

| Orderable part number     | Status<br>(1) | Material type<br>(2) | Package   Pins  | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|---------------------------|---------------|----------------------|-----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">LP2902D</a>   | Obsolete      | Production           | SOIC (D)   14   | -                     | -           | Call TI                              | Call TI                           | -40 to 85    | LP2902              |
| <a href="#">LP2902DR</a>  | Active        | Production           | SOIC (D)   14   | 2500   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | LP2902              |
| LP2902DR.A                | Active        | Production           | SOIC (D)   14   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | LP2902              |
| LP2902DR.B                | Active        | Production           | SOIC (D)   14   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | LP2902              |
| <a href="#">LP2902N</a>   | Active        | Production           | PDIP (N)   14   | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | -40 to 85    | LP2902N             |
| LP2902N.A                 | Active        | Production           | PDIP (N)   14   | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | -40 to 85    | LP2902N             |
| <a href="#">LP2902PW</a>  | Obsolete      | Production           | TSSOP (PW)   14 | -                     | -           | Call TI                              | Call TI                           | -40 to 85    | LP2902              |
| <a href="#">LP2902PWR</a> | Active        | Production           | TSSOP (PW)   14 | 2000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | LP2902              |
| LP2902PWR.A               | Active        | Production           | TSSOP (PW)   14 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | LP2902              |
| LP2902PWR.B               | Active        | Production           | TSSOP (PW)   14 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | LP2902              |
| LP2902PWRE4               | Active        | Production           | TSSOP (PW)   14 | 2000   LARGE T&R      | -           | Call TI                              | Call TI                           | -40 to 85    |                     |
| <a href="#">LP324D</a>    | Obsolete      | Production           | SOIC (D)   14   | -                     | -           | Call TI                              | Call TI                           | 0 to 70      | LP324               |
| <a href="#">LP324DR</a>   | Active        | Production           | SOIC (D)   14   | 2500   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | 0 to 70      | LP324               |
| LP324DR.A                 | Active        | Production           | SOIC (D)   14   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | LP324               |
| LP324DR.B                 | Active        | Production           | SOIC (D)   14   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | LP324               |
| LP324DRG4                 | Active        | Production           | SOIC (D)   14   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | LP324               |
| LP324DRG4.A               | Active        | Production           | SOIC (D)   14   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | LP324               |
| <a href="#">LP324N</a>    | Active        | Production           | PDIP (N)   14   | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | 0 to 70      | LP324N              |
| LP324N.A                  | Active        | Production           | PDIP (N)   14   | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | 0 to 70      | LP324N              |
| <a href="#">LP324PW</a>   | Obsolete      | Production           | TSSOP (PW)   14 | -                     | -           | Call TI                              | Call TI                           | 0 to 70      | LP324               |
| <a href="#">LP324PWR</a>  | Active        | Production           | TSSOP (PW)   14 | 2000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | 0 to 70      | LP324               |
| LP324PWR.A                | Active        | Production           | TSSOP (PW)   14 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | LP324               |
| LP324PWR.B                | Active        | Production           | TSSOP (PW)   14 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | LP324               |

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

<sup>(2)</sup> **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.

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

<sup>(4)</sup> **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.

<sup>(5)</sup> **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.

<sup>(6)</sup> **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



\*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 |
|-----------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LP2902DR  | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.35    | 2.3     | 8.0     | 16.0   | Q1            |
| LP2902PWR | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| LP2902PWR | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| LP324DR   | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.35    | 2.3     | 8.0     | 16.0   | Q1            |
| LP324DRG4 | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| LP324PWR  | TSSOP        | PW              | 14   | 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) |
|-----------|--------------|-----------------|------|------|-------------|------------|-------------|
| LP2902DR  | SOIC         | D               | 14   | 2500 | 367.0       | 367.0      | 35.0        |
| LP2902PWR | TSSOP        | PW              | 14   | 2000 | 353.0       | 353.0      | 32.0        |
| LP2902PWR | TSSOP        | PW              | 14   | 2000 | 356.0       | 356.0      | 35.0        |
| LP324DR   | SOIC         | D               | 14   | 2500 | 367.0       | 367.0      | 35.0        |
| LP324DRG4 | SOIC         | D               | 14   | 2500 | 340.5       | 336.1      | 32.0        |
| LP324PWR  | TSSOP        | PW              | 14   | 2000 | 356.0       | 356.0      | 35.0        |

## TUBE

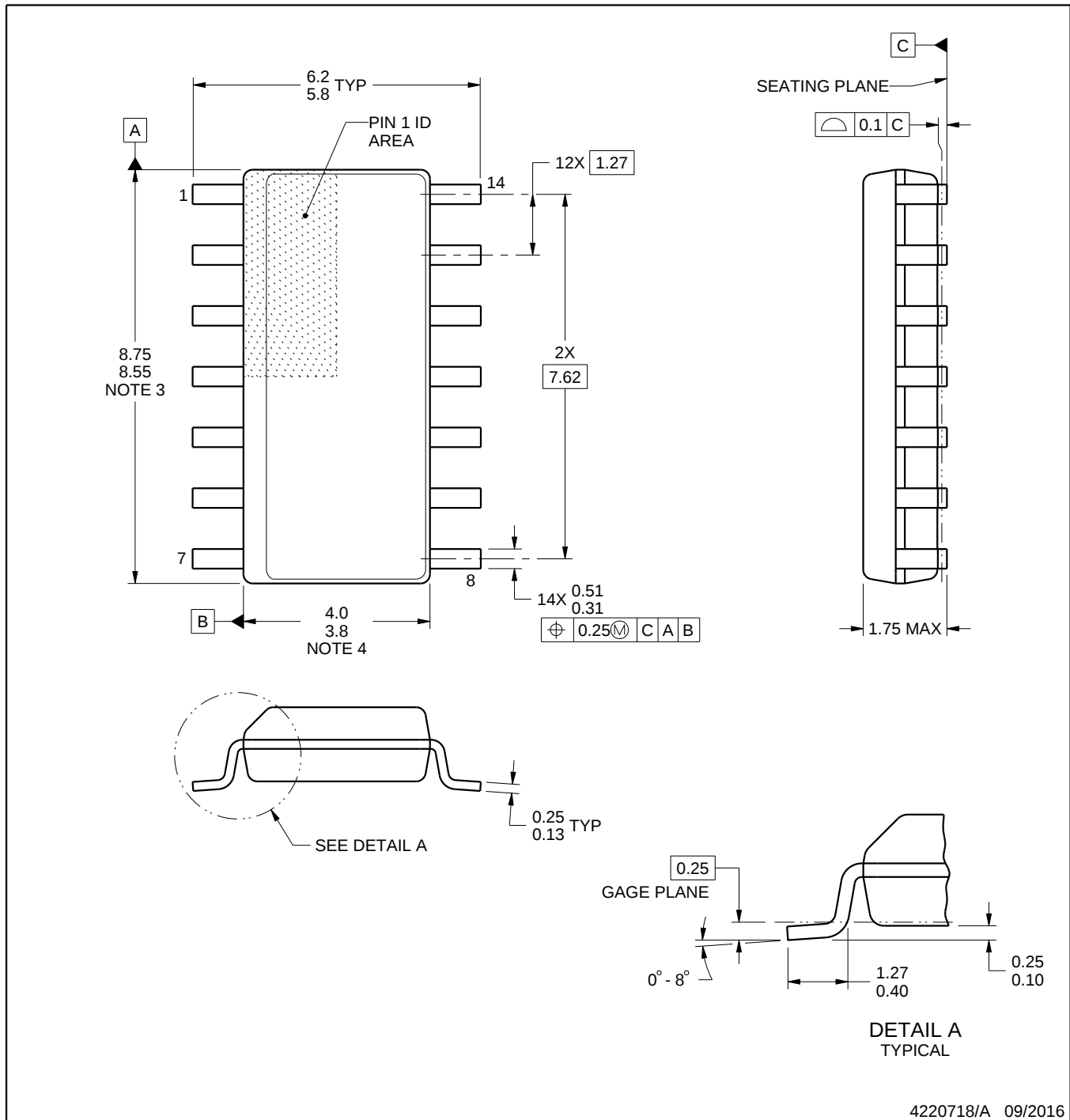


\*All dimensions are nominal

| Device    | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|-----------|--------------|--------------|------|-----|--------|--------|--------|--------|
| LP2902N   | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| LP2902N.A | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| LP324N    | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| LP324N.A  | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |

**D0014A****PACKAGE OUTLINE****SOIC - 1.75 mm max height**

SMALL OUTLINE INTEGRATED CIRCUIT



4220718/A 09/2016

**NOTES:**

1. All linear dimensions are in millimeters. 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 0.43 mm, per side.
5. Reference JEDEC registration MS-012, variation AB.

# EXAMPLE BOARD LAYOUT

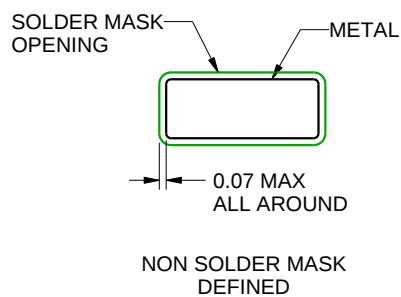
D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE  
SCALE:8X



SOLDER MASK DETAILS

4220718/A 09/2016

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

D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:8X

4220718/A 09/2016

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.

## N (R-PDIP-T\*\*)

16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



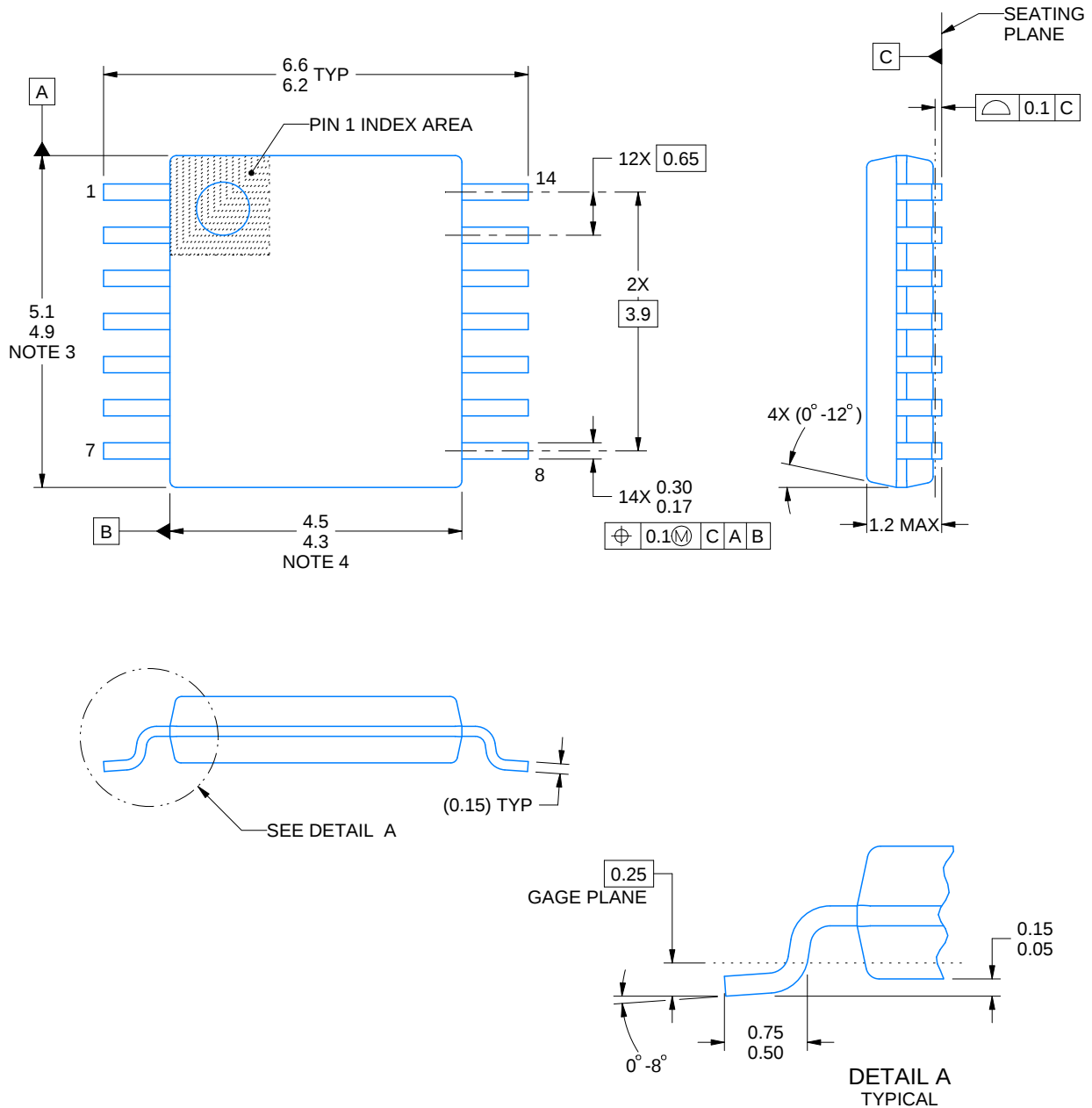
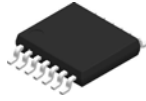
| PINS **             | 14               | 16               | 18               | 20               |
|---------------------|------------------|------------------|------------------|------------------|
| DIM                 |                  |                  |                  |                  |
| A MAX               | 0.775<br>(19,69) | 0.775<br>(19,69) | 0.920<br>(23,37) | 1.060<br>(26,92) |
| A MIN               | 0.745<br>(18,92) | 0.745<br>(18,92) | 0.850<br>(21,59) | 0.940<br>(23,88) |
| MS-001<br>VARIATION | AA               | BB               | AC               | AD               |



14/18 Pin Only  
20 Pin vendor option

4040049/E 12/2002

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
  - The 20 pin end lead shoulder width is a vendor option, either half or full width.



4220202/B 12/2023

## NOTES:

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

# EXAMPLE BOARD LAYOUT

PW0014A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



SOLDER MASK DETAILS

4220202/B 12/2023

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

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

# EXAMPLE STENCIL DESIGN

PW0014A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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

4220202/B 12/2023

NOTES: (continued)

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

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