适用于可穿戴设备光学心率监测、SpO2 和电生物传感的 AFE4950 超小型集成式 AFE

1 特性

- 支持同时且同步采集高达 24 相位的 PPG 和单引线 ECG 信号
- 在每个相位内均可实现灵活的 8 个 LED、4 个 PD 分配
- ECG 信号链：
  - 频率高达 2kHz 的单引线 ECG 信号采集
  - 用于驱动第三电极的 RLD 输出
  - 输入噪声：0.7μVrms
  - 支持最高 +/- 0.65V 的差分直流失调电压和 +/-0.55V 的共模范围
  - 可编程 INA 增益：11、21
  - 可实现快速饱和恢复的高通滤波器
  - 集成式 300Hz 抗混叠低通滤波器
  - 交流、直流导联脱落检测：2.6nA 至 85nA
  - 低功耗持续导联接通检测
- 阻抗信号链
  - 可对 2 个电极之间的阻抗进行持续低功耗监控
  - 7MΩ 范围
  - 620kΩ 上具有 300Ω 噪声
- PPG 发送器：
  - 8 位可编程 LED 电流，可调范围为 25mA 至 250mA
  - 并行点亮两个 LED 的模式
  - 支持 8 个采用共阳极配置的 LED，适用于 SpO2、多波长 HRM
- PPG 接收器：
  - 2 个并行接收器（两组 TIA/滤波器）
  - 支持到每个接收器的 4 路时分多路复用光电二极管输入
  - 每个 TIA 输入端的 8 位环境失调电压减法（256μA 范围）
  - 8 位 LED 失调电压减法 DAC（64μA 范围）
  - TIA 输入端的自动环境消除和动态 LED 直流消除
  - 在高达 10Hz 的频率下，环境抑制接近 100dB
  - 具有可编程带宽的噪声滤波功能
  - 跨阻增益：3.7kΩ 至 1MΩ
- 精确、连续的心率监测：
  - 在 16μA PD 电流下系统 SNR 高达 109dB
  - 用于在可穿戴设备上持续运行的低电流，其典型值为：LED 为 15μA，接收器为 20μA
- 外部时钟和内部振荡器模式
- 以与系统主时钟同步的方式采集数据
- 采样深度为 256 的 FIFO
- SPI、I^2C 接口：可通过引脚进行选择
- 2.6mm × 2.5mm DSBGA 封装，0.4mm 间距
- 电源：Rx：1.7V-1.9V（LDO 旁路）；1.9V-3.6V（LDO 使能），Tx：3V-5.5V，IO：1.7-RX_SUP

2 应用

- 用于可穿戴设备和耳戴式设备的光学心率监测 (HRM)
- 高性能 ECG 信号采集
- 同步监测 PPG 和 ECG 以便估算血压
- 心率变异分析 (HRV)
- 脉动式血氧计 (SpO_2) 测量

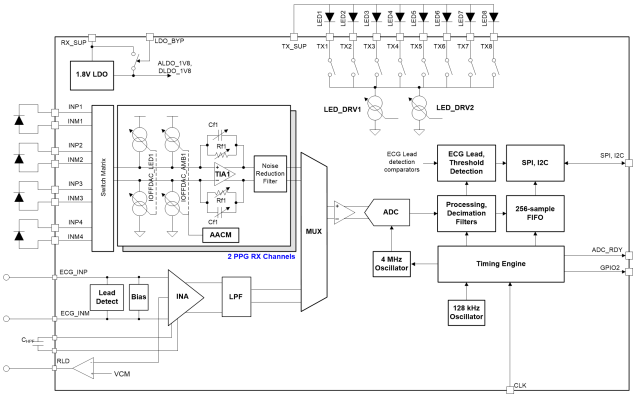
3 说明

AFE4950 器件是一款用于同步采集 PPG 和 ECG 信号的模拟前端 (AFE)。该器件还可用于心率监测 (HRM) 和外周毛细血管氧饱和度 (SpO2) 测量等光学生物传感应用。ECG 信号链支持双电极和三电极配置，并具有集成式右腿驱动 (RLD) 缓冲器。ECG 信号链还可用于以较低功耗连续监测一对电极间的阻抗。

器件信息

器件型号	封装(1)	封装尺寸（标称值）
AFE4950	DSBGA (36)	2.60mm × 2.50mm

(1) 如需了解所有可用封装，请参阅数据表末尾的可订购产品附录。



简化版原理图

4 Revision History

注：以前版本的页码可能与当前版本的页码不同

Changes from Revision * (June 2020) to Revision A (July 2020)	Page
• 将数据表从*预告信息*更改为*量产*数据	1

5 Description (continued)

The ECG signal chain can also be used to do a continuous, low-power monitoring of the impedance between a pair of electrodes.

6 Device and Documentation Support

6.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on 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.

6.2 Support Resources

TI E2E™ support forums are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

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6.3 Trademarks

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6.4 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.

6.5 Glossary

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

Mechanical, Packaging, and Orderable Information

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

PACKAGING INFORMATION

Orderable Device	Status (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
AFE4950YBGR	ACTIVE	DSBGA	YBG	36	3000	RoHS & Green	SAC396	Level-1-260C-UNLIM	-40 to 85	AFE4950	Samples
AFE4950YBGT	ACTIVE	DSBGA	YBG	36	250	RoHS & Green	SAC396	Level-1-260C-UNLIM	-40 to 85	AFE4950	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.
OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=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.

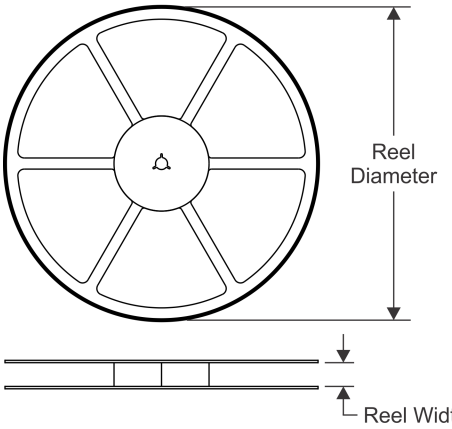
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(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.

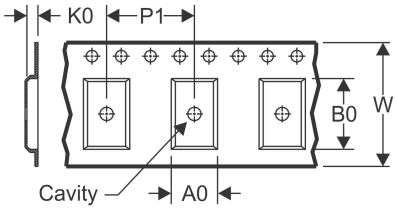
(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

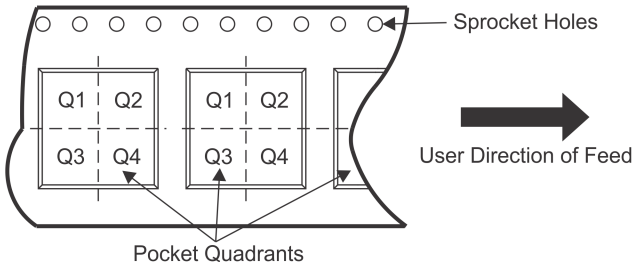


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

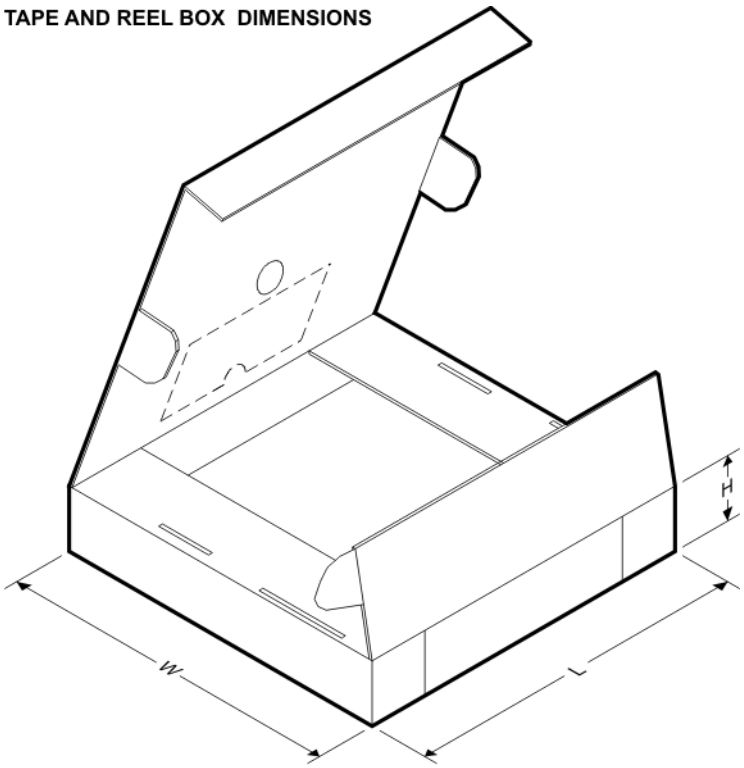
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
AFE4950YBGR	DSBGA	YBG	36	3000	330.0	12.4	2.64	2.8	0.74	8.0	12.0	Q1
AFE4950YBGT	DSBGA	YBG	36	250	330.0	12.4	2.64	2.8	0.74	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

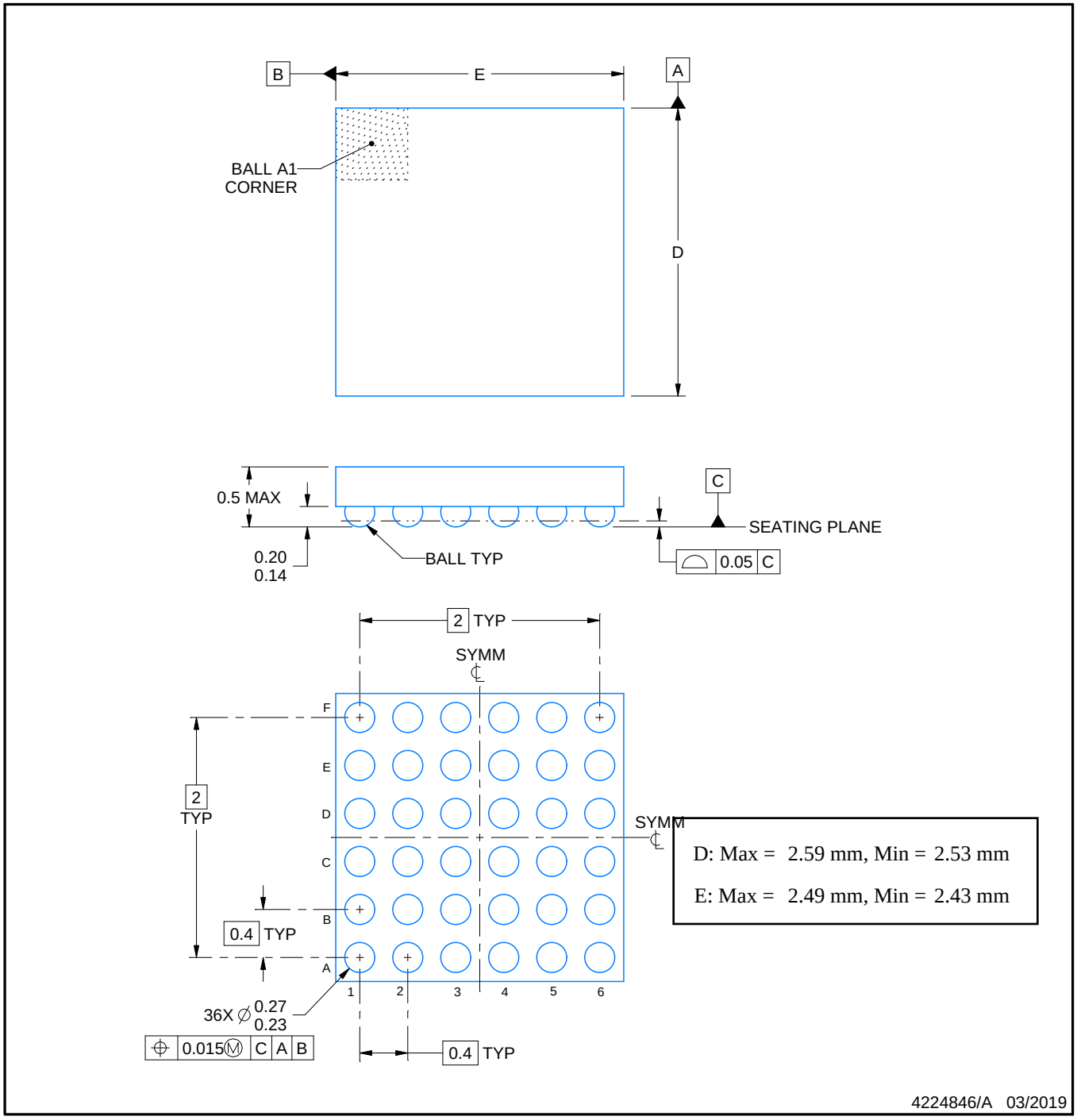
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
AFE4950YBGR	DSBGA	YBG	36	3000	345.0	365.0	55.0
AFE4950YBGT	DSBGA	YBG	36	250	345.0	365.0	55.0

YBG0036

PACKAGE OUTLINE

DSBGA - 0.5 mm max height

DIE SIZE BALL GRID ARRAY



NOTES:

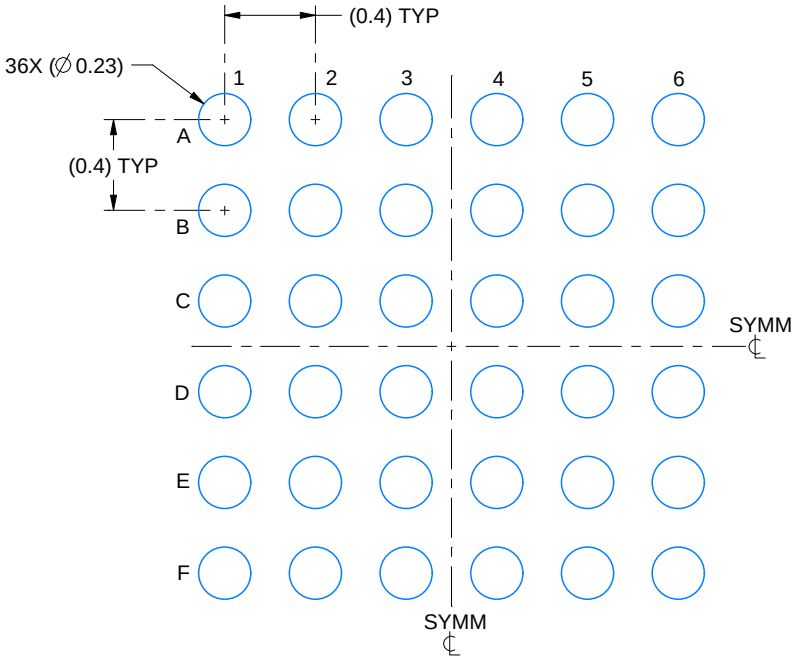
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.

EXAMPLE BOARD LAYOUT

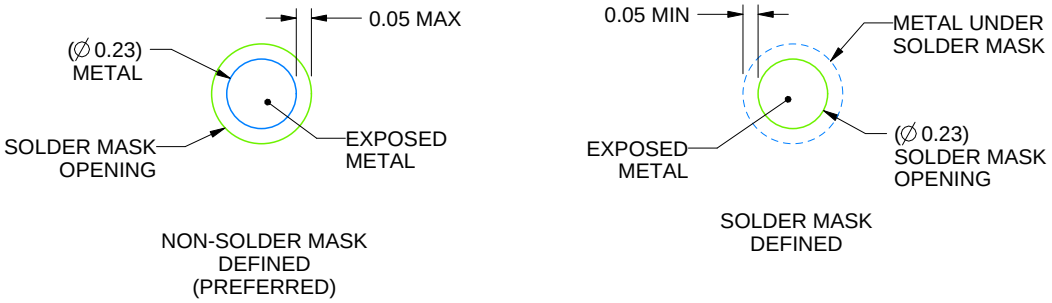
YBG0036

DSBGA - 0.5 mm max height

DIE SIZE BALL GRID ARRAY



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 30X



SOLDER MASK DETAILS
NOT TO SCALE

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NOTES: (continued)

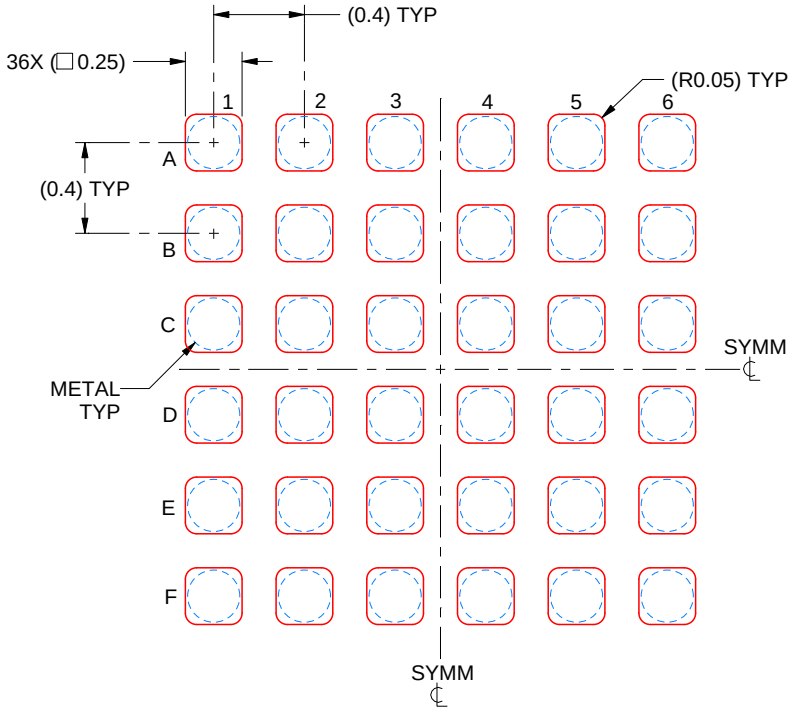
3. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints.
   See Texas Instruments Literature No. SNVA009 (www.ti.com/lit/snva009).

EXAMPLE STENCIL DESIGN

YBG0036

DSBGA - 0.5 mm max height

DIE SIZE BALL GRID ARRAY



SOLDER PASTE EXAMPLE
BASED ON 0.1 mm THICK STENCIL
SCALE: 30X

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NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release.

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