*Application Brief*
# Optimizing Board Design for Supply Constrained Environments

**TEXAS INSTRUMENTS**

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## Introduction

To get the most out of your board space and the wide selection of packages available from Texas Instruments, consider using a dual footprint. The term *dual footprint* here refers to overlaying two PCB landing pads for two different package configurations. In supply constrained environments, this is a great method to mitigate supply issues for new designs or board spins.

There are many different package types and configurations available that enable overlaying their landing pads while occupying an optimized board area. Clearance rules must always be observed and are dependent on voltage and power requirements. TI's logic devices work at low voltages, so generally clearances are very small and allow for this type of operation. This application brief provides examples for common logic packages both leaded and unleaded. All examples have a minimum of 5 mil clearance between any traces.

## Leaded to Unleaded Packages

Combined footprints from leaded to unleaded packages are ideal as long as the packages have the same pin count and similar pin orientation. TI's latest QFN packages are some of the industries smallest packages, they easily fit inside the land pattern of numerous larger leaded packages. This allows for easy routing to each corresponding pin without any vias. An ample amount of TI's most popular devices are offered in both leaded and unleaded packages, allowing for effortless drop-in replacements.
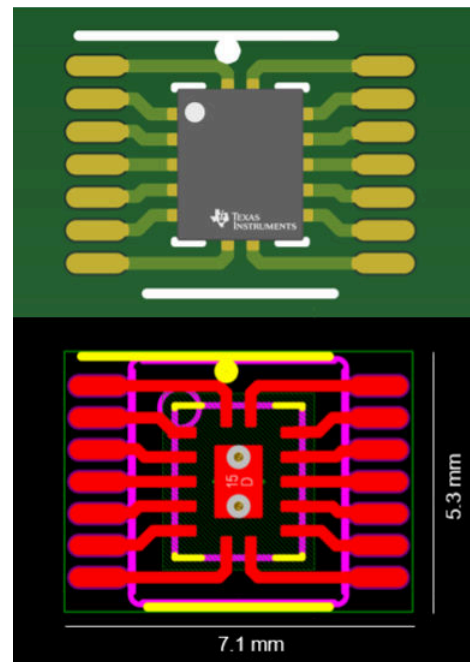


**Figure 1. PW + BQA Dual Footprint**

Figure 1 shows a dual footprint for a TSSOP (PW) 14-pin package and a WQFN (BQA) 14-pin package.

### Package Sizes:

- 14-Pin PW: **37.63** mm$^2$
- 14-Pin BQA: **11.16** mm$^2$

### Total Board Space Used:

- PW + BQA: **37.63** mm$^2$

TI's latest logic family, HCS, offers the most popular functions in the PW, DYY and BQA packages.

**Table 1. Recommended Parts**

| Part Number | Vcc Range | Type | Features |
|---|---|---|---|
| SN74HCS08 | 2 V to 6 V | AND Gate | Schmitt-trigger inputs 4 Channels |
| SN74HCS32 | 2 V to 6 V | OR Gate | Schmitt-trigger inputs 4 Channels |
| SN74HCS14 | 2 V to 6 V | Inverter | Schmitt-trigger inputs 6 Channels |
| SN74HCS125 | 2 V to 6 V | Buffer | Schmitt-trigger inputs 3-State outputs 4 Channels |

## Leaded to Leaded Packages

Leaded packages are easily leveraged for dual footprints as long as the packages have the same pin count and similar lead pitches. Board traces are routed between the corresponding pins of each package. Vias can be used to connect certain leads between packages to meet PCB trace clearance rules.

When combining packages with similar pin configurations the smaller package footprint can sometimes be used within the land pattern area of the larger package. Figure 2 shows an example of this for an SOT (DYY) and a TSSOP (PW) package.
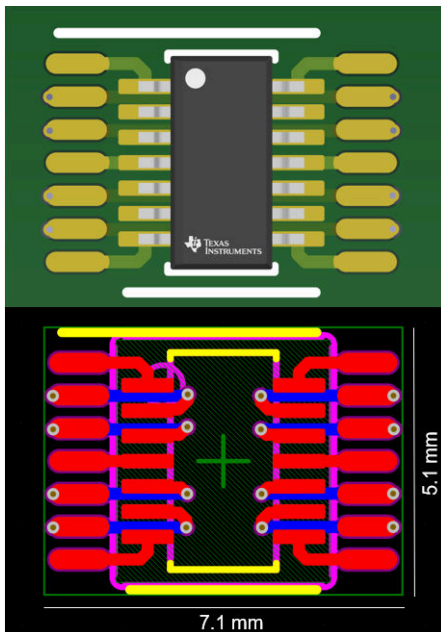


**Figure 2. PW + DYY Dual Footprint**

**Package Sizes:**

- 14-Pin PW: **37.63** mm$^2$
- 14-Pin DYY: **20.4** mm$^2$

**Total Board Space Used:**

- PW + DYY: **37.63** mm$^2$

Package combinations where the smaller package does not fit inside the larger package can still be used in dual footprints by overlapping the packages as shown in Figure 3. The board space used only increases by 15% when compared to a single footprint alternative.
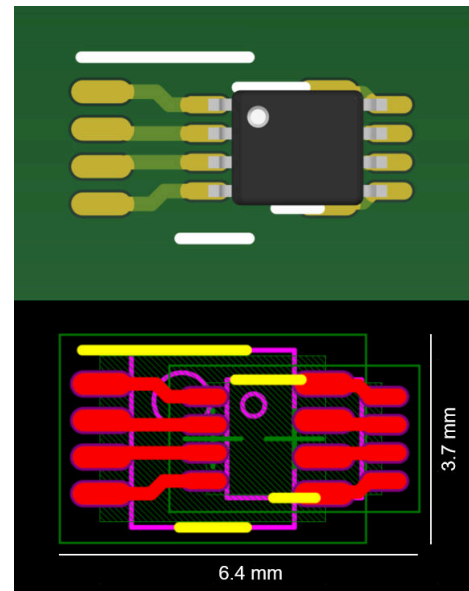


**Figure 3. DCU + DCT Dual Footprint**

Figure 3 shows a dual footprint for a VSSOP (DCU) 8-pin package and a SSOP (DCT) 8-pin package.

**Package Sizes:**

- 8-Pin DCU: **11.57** mm$^2$
- 8-Pin DCT: **20.17** mm$^2$

**Total Board Space Used:**

- DCU + DCT: **23.68** mm$^2$

TI's most popular logic family, LVC, offers the most popular functions in the PW, DCU and DCT packages.

**Table 2. Recommended Parts**

| Part Number | Vcc Range | Type | Features |
|---|---|---|---|
| SN74LVC08A | 1.65 V to 3.6 V | AND Gate | High drive strength 4 Channels |
| SN74LVC2G32 | 1.65 V to 5.5 V | OR Gate | High drive strength 2 Channels |
| SN74LVC14A | 1.65 V to 3.6 V | Inverter | High drive strength 6 Channels |
| SN74LVC125A | 1.65 V to 3.6 V | Buffer | High drive strength 3-State outputs 1 Channel |

## Conclusion

Dual footprints are an excellent method to future-proof your designs, providing multi-sourced sockets to prevent supply constraints while maintaining similar size to a typical single footprint option. The combined footprints shown are just a few examples. Many more package combinations are possible using the huge portfolio available from TI.

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