

REV_A

UNDERSTANDING “NVTA” FOR LAYOUT CONSIDERATIONS OF NEXT GENERATION XINGER DIRECTIONAL COUPLERS

The Next Generation of Xinger Directional Couplers use patented “NVTA” non-vertical-transition architecture, eliminating the internal signal vias in traditional surface-mount directional couplers. With all RF current flowing on the surface of the customer’s carrier board the design achieves exceptionally low insertion loss, improved thermal performance, and a thinner overall form factor.

Unlike printed couplers—whose performance depends heavily on PCB stack-up, dielectric tolerance, and geometry— the new Xinger solution provides stable, factory-controlled performance without tuning. Recommended top-level PCB layout is still required to maximize our users’ flexibility:

- Uses standard IPC SMT mounting guidelines with performance not impacted by typical alignment tolerances
- Eliminates fabrication-driven variation of printed-couplers

Overall, the Next Generation Xinger Coupler provides a simpler, more predictable, and higher-efficiency option for modern RF systems where size, loss, and reliability are critical while maintaining the high quality and reliability that standard Xinger couplers offer.

Introduction

Directional couplers are widely used in RF systems for power monitoring, signal sampling, feedback control, and protection functions. As operating frequencies increase and systems demand tighter size, loss, and thermal requirements, the way a coupler integrates with the customer’s PCB becomes a critical driver of overall performance. Like the current generation of Xinger couplers, the Next Generation of Xinger directional couplers are comprised of CTE-matched materials with the industries’ most common PCB substrates and RoHS-compliant final finishes. This Next Generation of Xinger couplers also utilizes a new proprietary material set that is PFAS compliant!

Typical Surface-Mount Directional Coupler Configuration

Conventional surface-mount directional couplers typically rely on internal layer transitions to complete the RF signal path. In a traditional coupler configuration:

1. The RF signal enters the component on the top layer.
2. Current transitions vertically through internal metallization.
3. The bottom layer acts as ground reference.
4. The signal returns to the surface through another vertical transition.

Traditional couplers now exhibit previously unnoticed limitations due to existing manufacturing capabilities and available materials. The introduction of TTM’s new and innovative directional couplers is suited for large-scale production by taking advantage of recent improvements in manufacturing capabilities and newly available materials.

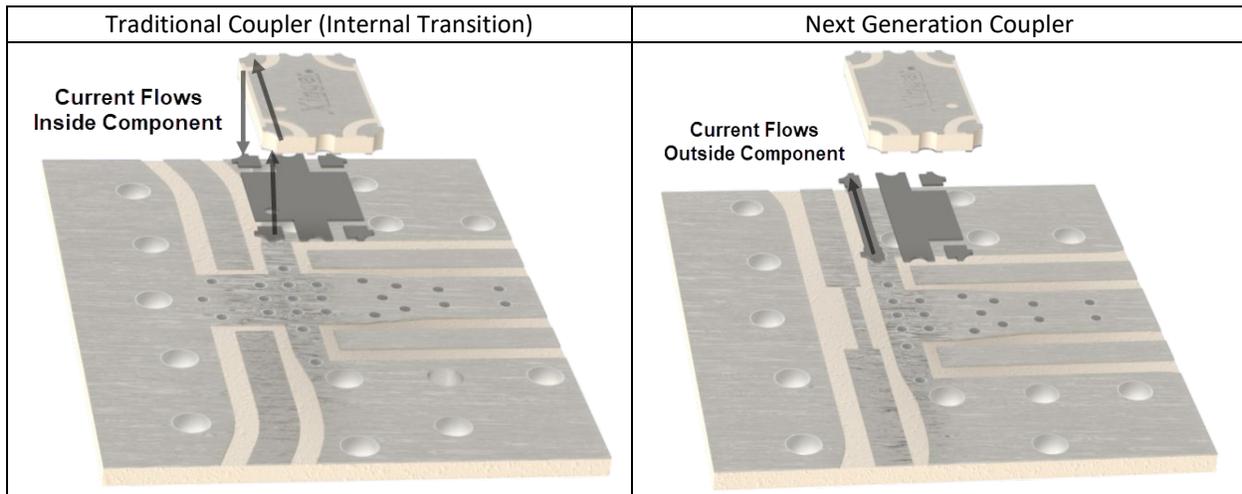


Figure. Typical surface mount coupler configuration

Implications of Vertical Current Transitions

Traditional SMT couplers rely on vertical vias to route RF current between internal layers. When the current switches from horizontal traces into vertical paths, current crowding increases resistive loss, directly raising insertion loss.

At the same time, the vias introduce parasitic inductance and capacitance, which distorts the coupling structure and limit the achievable bandwidth, especially at higher frequencies.

Next Generation Xinger Directional Coupler Benefits

The Next Generation Xinger design fundamentally changes how RF current flows through the component. This innovation has improved benefits when compared to both traditional surface mount components and printed couplers.

Benefits over traditional SMT couplers:

- Undetectably low insertion loss
- Improved power handling capabilities
- Reduced form factors in X, Y, and Z
- PFAS compliant
- CTE-matched materials with common PCB substrates
- RoHS-compliant final finish
- Follows IPC-7352, IPC-7351, and IPC-7525 SMT mounting requirements

Benefits from typical printed couplers:

- Wide bandwidth in compact form factor
- Low insertion loss
- No tuning requirements

Improved Power Handling

Elimination of vertical transitions for RF current minimizes heat generated within the component. Traditional couplers dissipate heat within the component at a 45° spread with performance driven by internal material properties.

The Next Generation Xinger Coupler eliminates this restriction with the direct line being placed directly on the carrier board for an optimal thermal path. Thus, the system performs similarly to a printed coupler where RF power dissipation remains along the carrier board direct line rather than within the component.

To maintain electrical and thermal performance of the system it is recommended the carrier board main line temperature is maintained following recommended mounting temperature outlined in component data sheet.

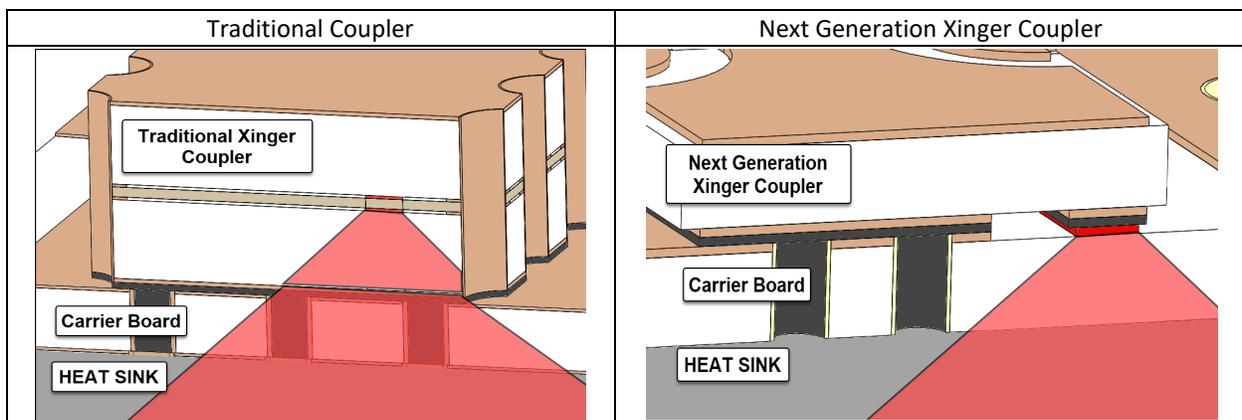


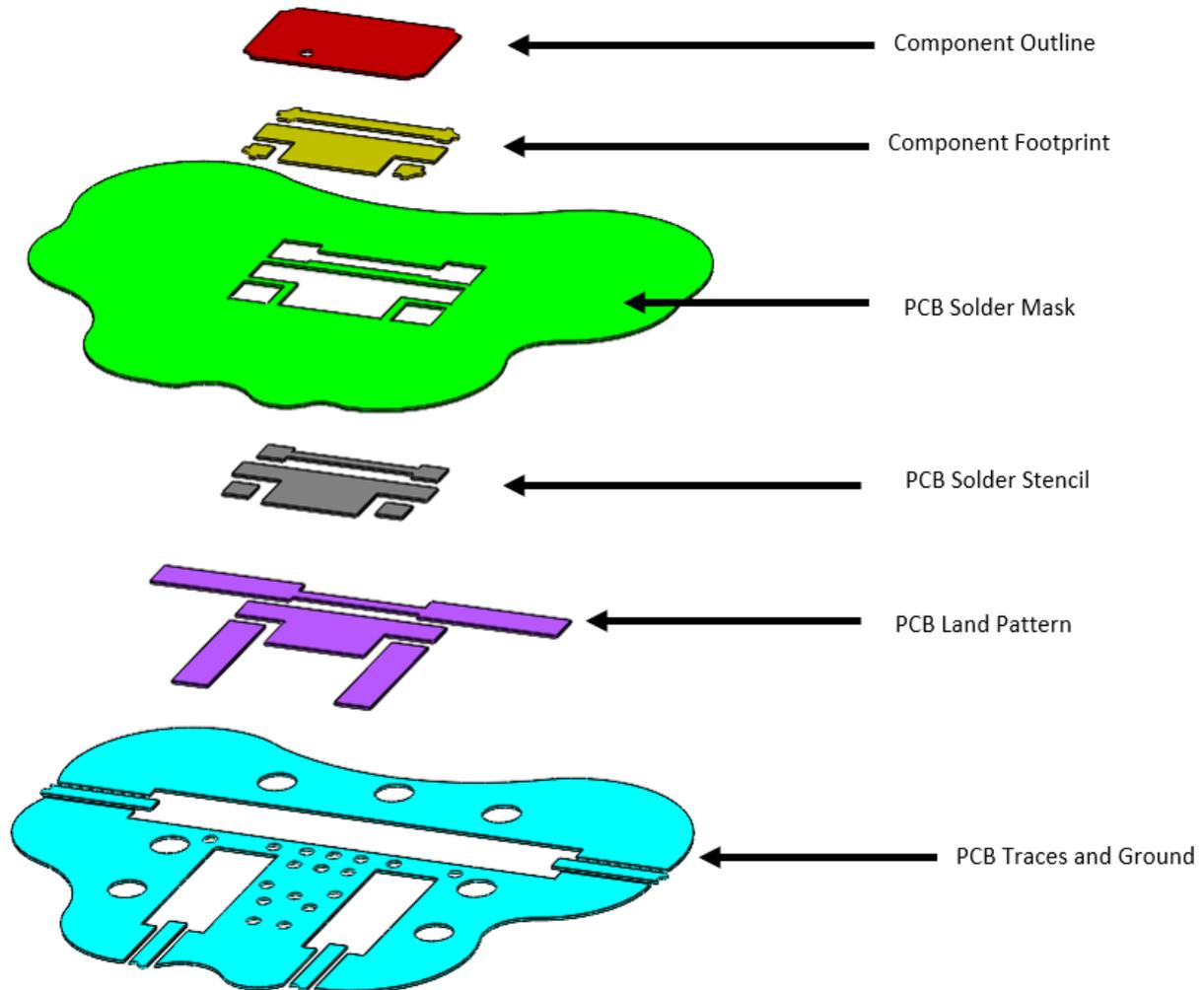
Figure. Xinger Surface Mount Coupler Heat Dissipation

Recommended PCB Layout Guidelines

To fully benefit from the Next Generation Xinger and its NVTa architecture, the following layout practices are recommended. Mounting footprint configurations follow equivalent recommendations to our existing Xinger surface mount couplers which are outlined by IPC-7352, IPC-7351, and IPC-7525. Carrier board land pattern is driven by carrier board Dk, thickness, and target frequency.

Layer definitions:

- Component Outline: Overall shape of the part including orientation marker
- Component Pads: Outline of I/O port and ground pads
- Recommended PCB features (for optimal RF performance)
 - o PCB Land Pattern: A combination of lands that is used for the mounting, interconnection and/or testing of a particular component
 - o PCB Traces and Ground: A representative layout of traces and ground
 - o PCB Solder Mask: Recommended solder mask opening required for soldering
 - o PCB Solder Stencil: Recommended feature location for solder connection



Conclusion

The Next Generation Xinger Directional Coupler introduces the all new patented NVTA approach which is a surface-current-based architecture that significantly improves insertion loss and power handling compared to traditional SMT coupler designs. This innovation provides the same high quality and reliability as traditional Xinger couplers and utilizes CTE-matched materials with common PCB substrates, has a RoHS-compliant final finish, and is PFAS compliant.

By following the layout guidelines presented in this application note, designers can:

- Simplify RF routing
- Achieve undetectable insertion loss and more predictable RF performance
- Expect equivalent thermal robustness compared to printed couplers
- Easily implement coupler following standard IPC SMT mounting requirements

This makes the Next Generation Xinger Directional Coupler well suited for compact high-power applications where efficiency, space, and reliability are critical.

The family of Next Generation Xinger Directional Couplers are in development and list below is subject to change. Please reach out to TTM RF&S customer service for most up to date listings of available parts and sample availability.

| Part Name | Frequency Range | Sample Availability |
|------------------|------------------------|----------------------------|
| XNGC09P2-30S | 700-1000 MHz | May 2026 |
| XNGC20F2-30S | 1400-2700 MHz | Yes |
| XNGC40F2-30S | 3200-4200 MHz | March 2026 |