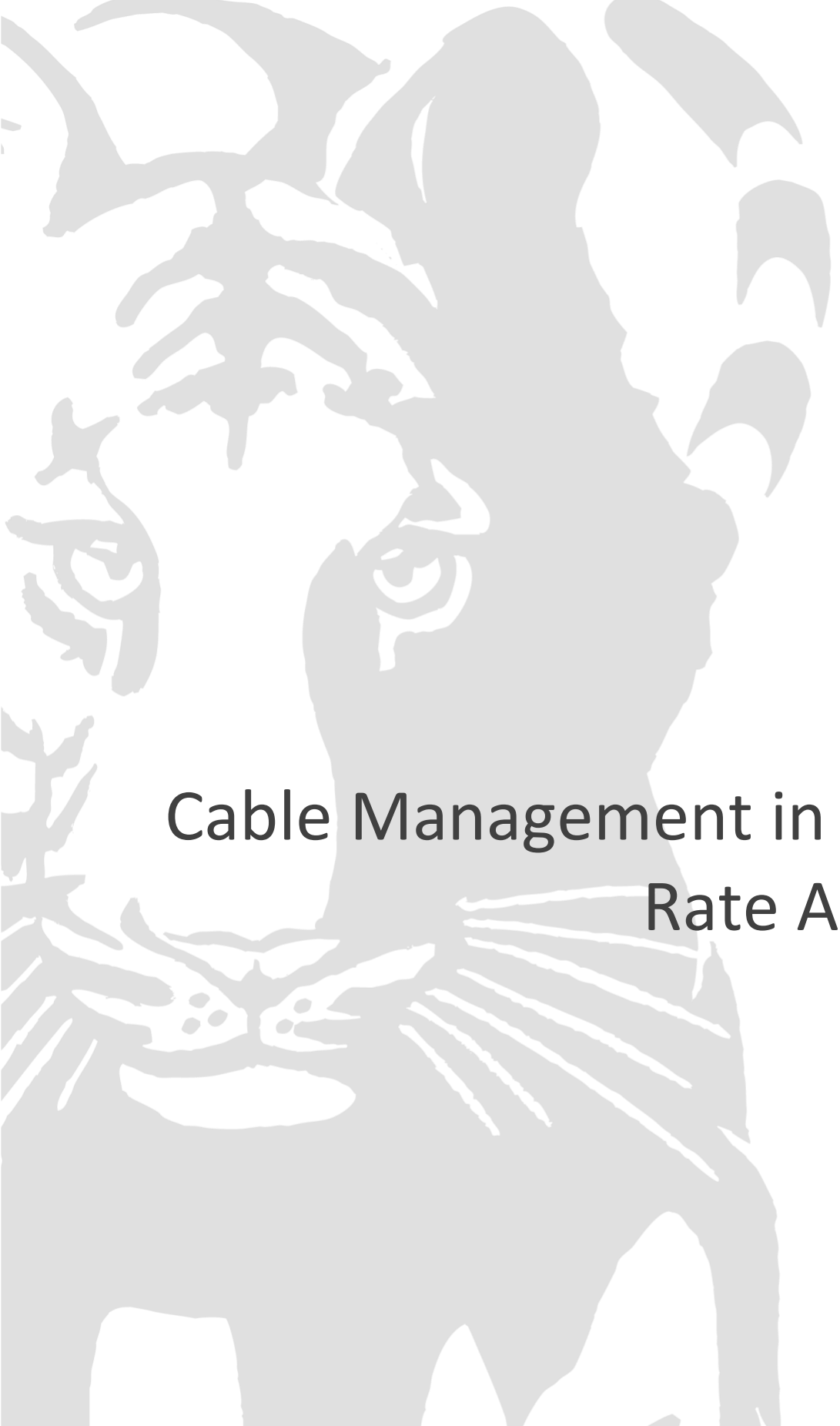

Cable Management in High-Data-Rate Applications

August 2025

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Abstract

This guide explains the major considerations to optimize Samtec cable management in high-data-rate and high-speed applications, including methods to avoid and fix common cable management issues.

Integration Leads to Innovation

Samtec is structured like no other company in the interconnect industry: We work in a fully integrated capacity that enables true collaboration. The result is innovative solutions and effective strategies supporting optimization of the entire signal channel.

For more information contact SIG@samtec.com

Introduction

This document explains the major considerations to optimize Samtec cable management in high-data-rate (HDR) and high-speed applications (see Figure 1), including methods to avoid and fix common cable management issues. Note: It is important to check individual product data sheets [1] for specific information on best-handling practices, mating procedures, static cable minimum bend radius, dynamic flex ratings, etc.

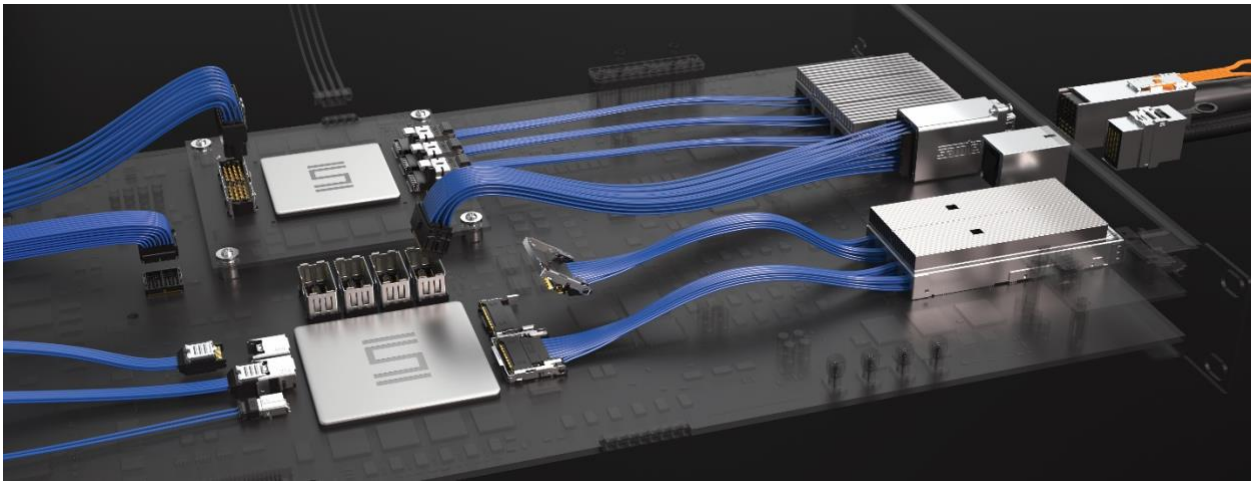

Figure 1: High-Data-Rate (HDR) cable assemblies can be used in mid-board, front-panel, and backplane Flyover® applications.

Getting Started

During early system architecture design, it is very important to perform an optimization study between signal integrity (SI), thermals, cable management, and manufacturing assembly.

Samtec offers the following services and support tools (email HDR@samtec.com for more information):

- Complimentary consulting services
- Full channel SI models and test kits [2,3]
- System thermal analysis to calculate pressure drop in cabled systems
- Cable management mock-ups

Cable Management Considerations

The following sections describe typical areas of concern for cable management and how to address them. For optimal installation, the appropriate length cables should be routed in an organized fashion, and cables should be bent and twisted properly.

Bending Cable

Consider the cable's static minimum bend radius (the smallest radius the cable can be bent without degrading performance). Note: Bend radius applies to an individual strand of cable, or for a row of cables that are not bunched together.

Twinax gauge can also affect minimum bend radius. Refer to the specific product series and cable type documentation for bend radius as it varies [1]. For example, Samtec 34 AWG twinax and coax minimum bend radius is 3.1 mm (0.125"). These values are found in the product's data sheet (see Figure 2 below for a sample) on Samtec's website.

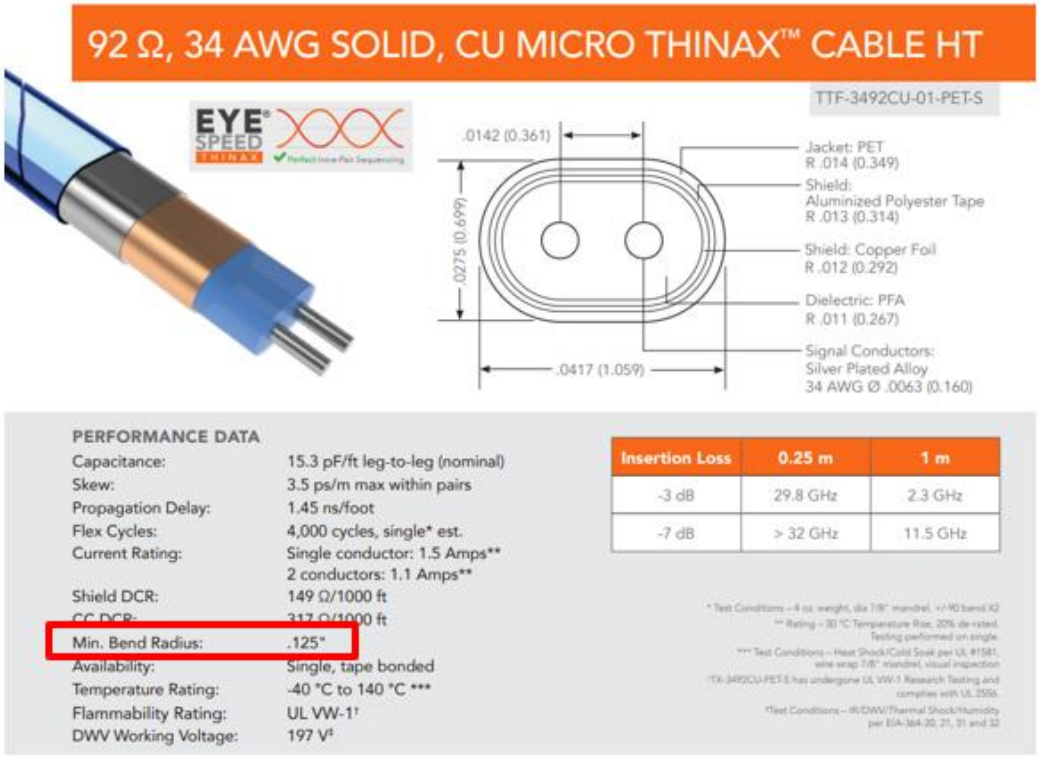

Figure 2: Minimum bend radius is specified on each cable product's data sheet.

Important considerations:

- Avoid bunching cables, especially at the cable exit
- If cables are bunched together, then the minimum bend radius will be significantly greater depending upon the number of cables

- At the cable exit, let the cables splay out so that a tight bend radius can be achieved without putting stress on the connector (see Figure 3)

Figure 3: It is best to allow cables to splay to avoid putting stress on the connector.

Twisting Cable

For best performance, minimize the amount of cable twisting. Twisting can be useful in cable routing when you need to route the cable sideways (see Figure 4).

Figure 4: Implementing a bend and a twist is best practice to bend along the length of the connector.

Here are some guidelines:

- Maximum twist of an individual strand of twinax/coax is 90° per 1.5"of cable length
- Twisting a group of cables bunched together is challenging as the bundle is significantly stiffer than individual cables
- In order to exit the cable along the length of the connector:
    - Bend the cable first in the preferred direction and then make a 90° twist along the length of the connector (see Figure 5, right image)
    - This is easier to achieve when cables are loosely held instead of bunched together

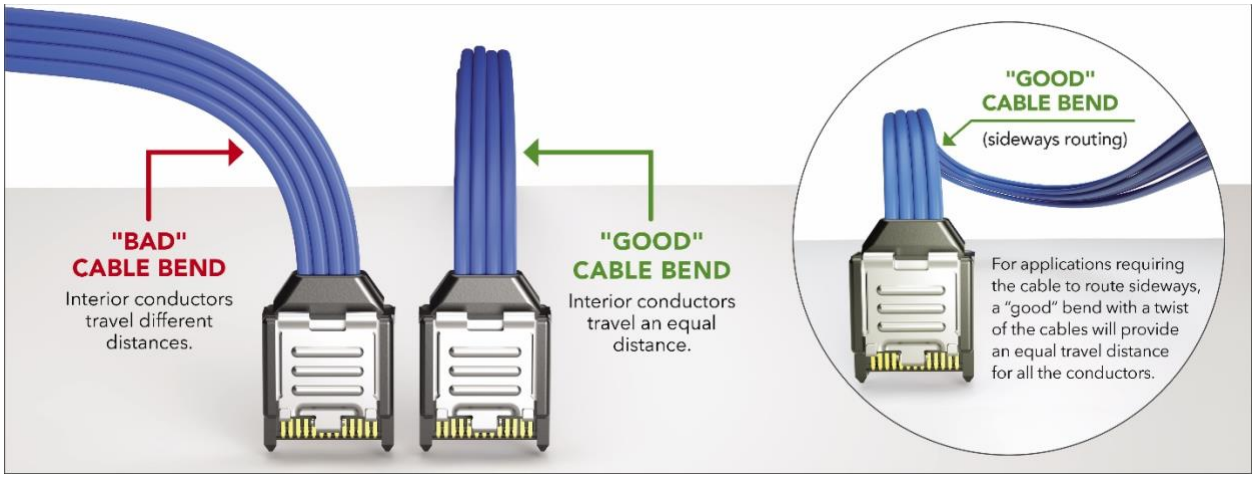

Figure 5: Best practices include a "good" way to bend a cable (center), keeping the conductors at consistent lengths. To bend in a "bad" direction, such as along the length of the connector, it is best to bend and then twist the cable as shown in images to the right.

Cable Sleeves

The purpose of sleeves is to protect the cable jacket material (see Figure 6) from nicks and cuts, as well as provide an initial level of cable management. Sleeves are particularly useful in applications with large quantities of cables to assist with visual cable management and cable routing. Samtec offers a variety of sleeves that can be added to our cable assemblies. (Sleeve options need to be fully defined at the time of ordering. Most catalog standard part numbers do not include sleeves, so these would be handled under customer-defined HDR part numbers to accommodate sleeves. For more information contact HDR@samtec.com.)

Best practices for sleeve usage:

- Use sleeves only in areas where cables could get damaged
- Keep sleeves away from areas where there are tight bends in the cables
- Use oversized stretchable sleeves, as they allow the cables to splay at gentle turns. Samtec has tape available for edges if necessary
- Do not put large labels on sleeves (specifically in areas where bends are required) as they stiffen the sleeve and make it hard to bend the cable

Figure 6: When used properly, sleeves can protect the cable jacket material.

Slack

Cables must have slack to prevent constant stress from being applied to the mating interface and solder joints. Select your cable length to allow for slack.

Some guidelines regarding slack:

- Consider cable length based on final mated condition as well as insertion/removal conditions, especially for short (<10 inches/25 cm) cables
- Where slack is not possible, check the Design Qualification Test Report for maximum allowable normal and side loads (example shown in Figure 7). These reports are located on each product series' webpage under "Test Reports"
- If forces are higher than recommended, it is recommended to transfer the loads to the chassis/PCB instead of the connector using cable management hardware
- If compressive loads are inevitable on the cables, then it is good to give them a degree of freedom to splay out in order to lower the transfer of load to the connector

Cable Pull force

- **90° Pull Lateral**
  - **Min----------13.30 lbs**
  - **Max----------15.79 lbs**
- **90° Pull Vertical**
  - **Min----------6.00 lbs**
  - **Max----------6.56 lbs**

Latch Retention

- **Min----------16.06 lbs**
- **Max----------17.42 lbs**

Figure 7: Samtec Design Qualification Test Reports include information on cable pull forces.

Labels

Labels can be customized in size, color, and location to aid with assembly, tracking lot#, etc. Catalog standard drawings identify the default label criteria. If customers prefer a customized label, they will need to contact HDR@samtec.com to speak with an application engineer. Samtec will then set up a customer-defined HDR part number to quote the design.

Best practices for label placement on cables (see Figure 8):

- Minimize label size
- Do not wrap labels tightly around a bundle of cables as it will prevent bending, unless that is desired.
- Attach label to an individual strand
- Place label away from tight bends

Figure 8: Be mindful of how label placement can impact cable forces.

Resources

Samtec's high-speed board-to-cable and Flyover® cable systems provide innovation for next generation architectures with industry leading support, in-house manufacturing, and customization capabilities to create a solution for any application. Samtec cable management experts are available to assist with your cable management challenges. You can reach Samtec application engineering at HDR@samtec.com. Other resources include the Samtec High-Speed Cable Solutions Guide, and the Samtec High Speed Cable Solutionator.

References

[1] Samtec Cable Data Sheets

[2] 3D Models

[3] Samtec Evaluation and Development Kits