ERICSSON

RDI Cabling Guidelines

User Guide

15/1553-FGB 101 0308/1 Uen M4A

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Contents

1 Introduction

This document describes the Radio Dot Interface (RDI). The RDI is cables, patch panels, and connectors between the Indoor Radio Unit (IRU) and the Radio Dot (RD) in the Radio Dot System (RDS).

This document describes the recommended installation method and procedure. Local adjustments and requirements are planned in the rollout project.

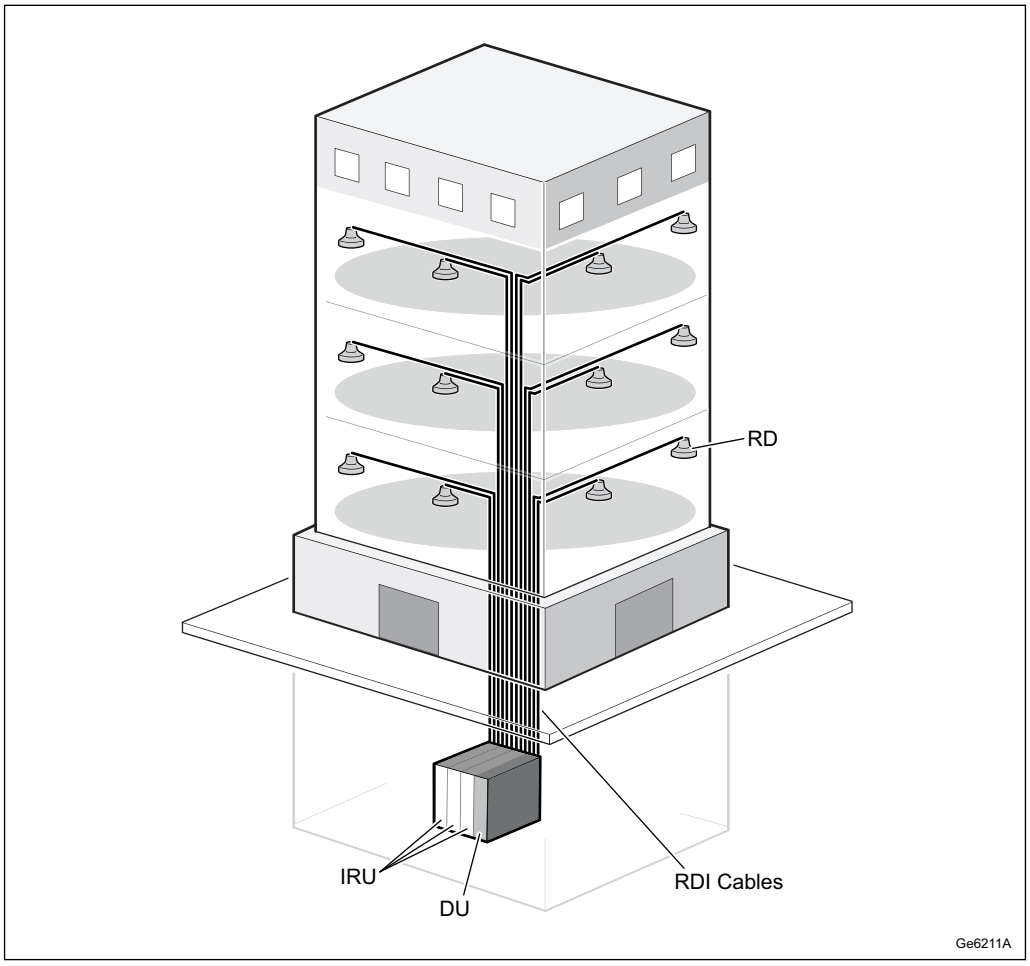


Figure 1 Radio Dot System

1.1 Target Group

The target group for this document is network design, site acquisition, site engineering, network engineering, field installation, and integration.

1.2 Documentation

Ensure that the following documents are read and understood:

— *Personal Health and Safety Information*, 124 46-2885

— *System Safety Information*, 124 46-2886

— *Handling Faulty Equipment*, 2/1541-LZA 701 6001/1

— *RDS Site Product Overview*, 5/1551-FGB 101 0308/1

2 Radio Dot Interface Overview

The RDI is all cables and connectors between the Indoor Radio Unit (IRU) and the Radio Dot (RD).

The RDI can be divided into three parts:

— RDI feeder cables - RDI permanent link. Between the patch panel and the connection box (optional)

— RDI patch cables - cables between IRU and patch panel

— RDI jumper cables - patch cables between Radio Dot and connection box (optional)

Figure 2 shows an example configuration with RBS 6202.

Figure 3 shows an example configuration with RBS 6202, without connection box.

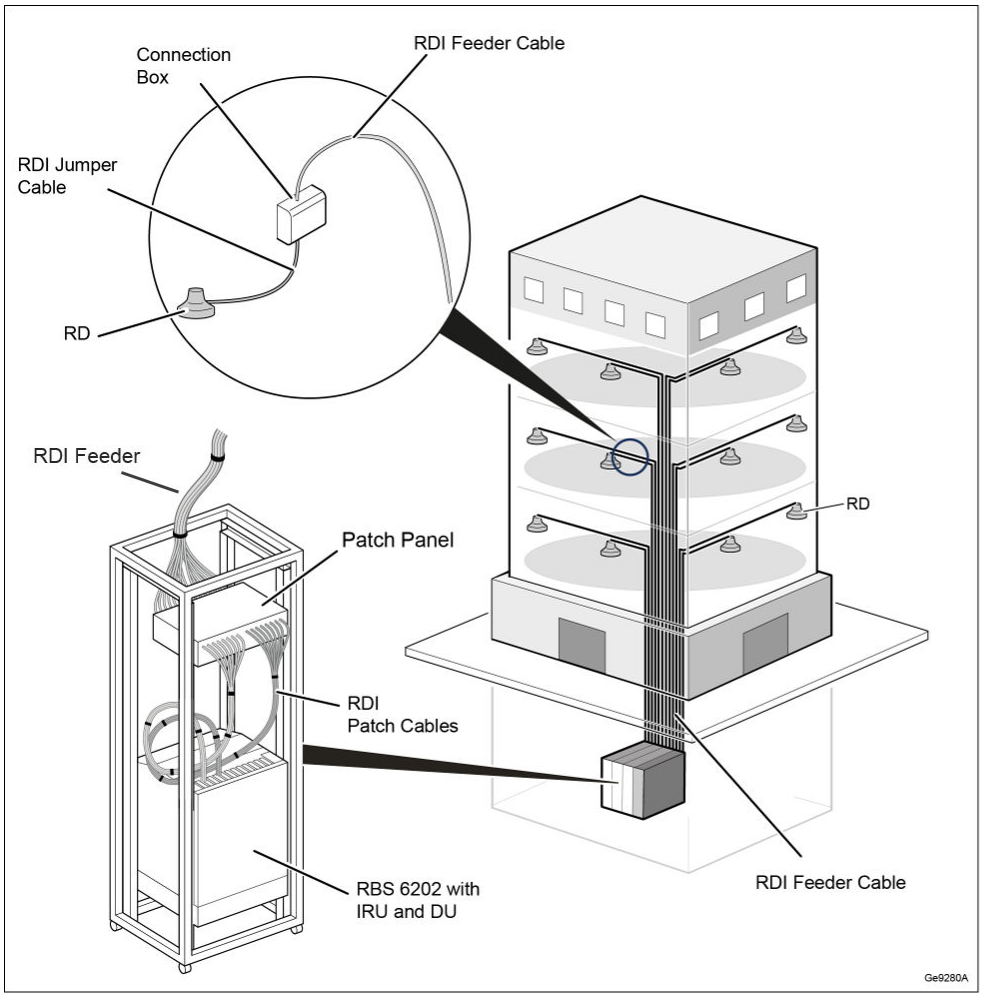


Figure 2 RDI Overview, Example Configuration with Patch Panel and Connection Box

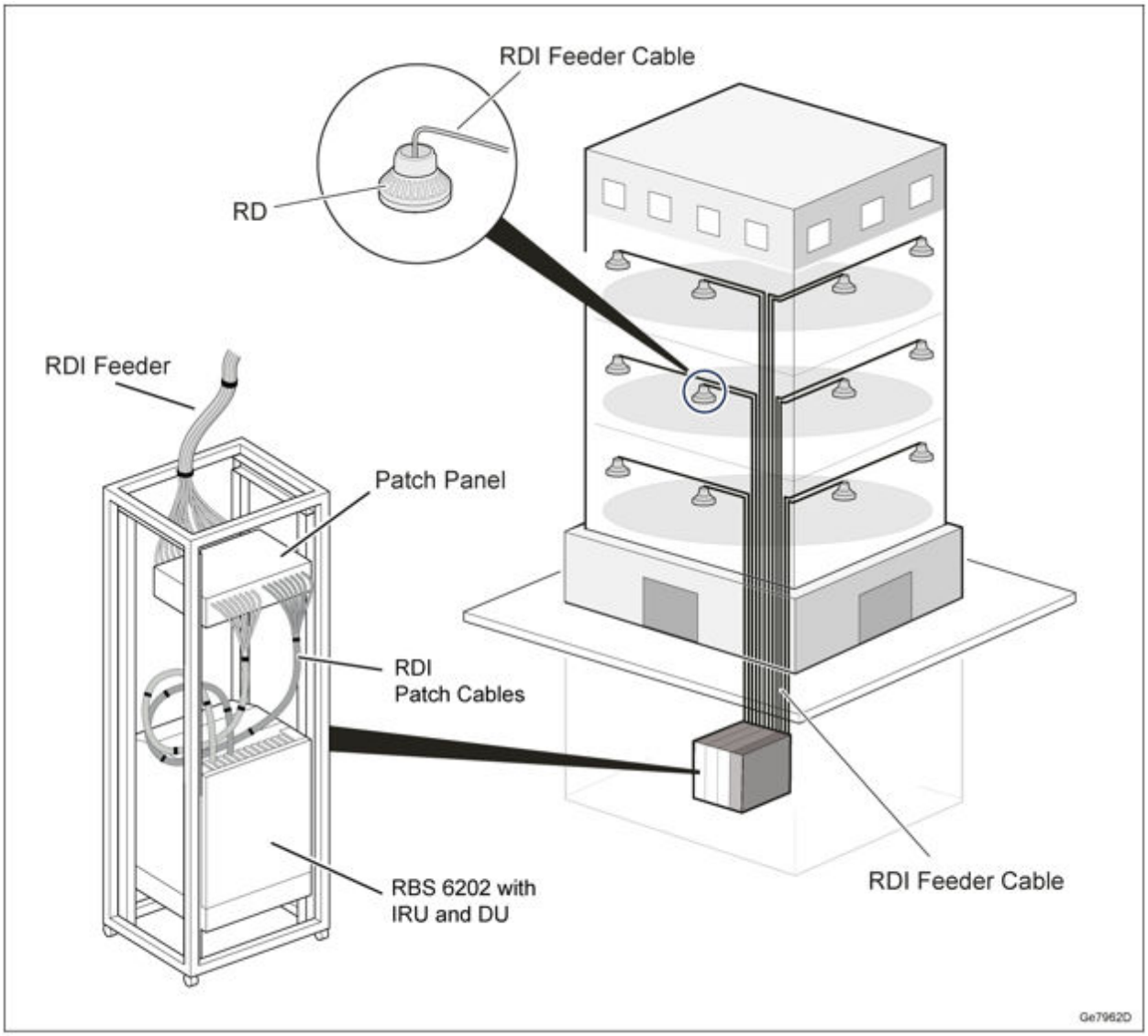


Figure 3 RDI Overview, Example Configuration without Connection Box

The typical deployment requires a patch panel. The patch panel is of the type without ports already installed to allow for the terminated feeder cable to clip into it. For supplemental details on the patch panel and the termination of the feeder cable, refer to Cable Termination and Patch Panel Guidelines, 9/1553-FGB 101 0308/1.

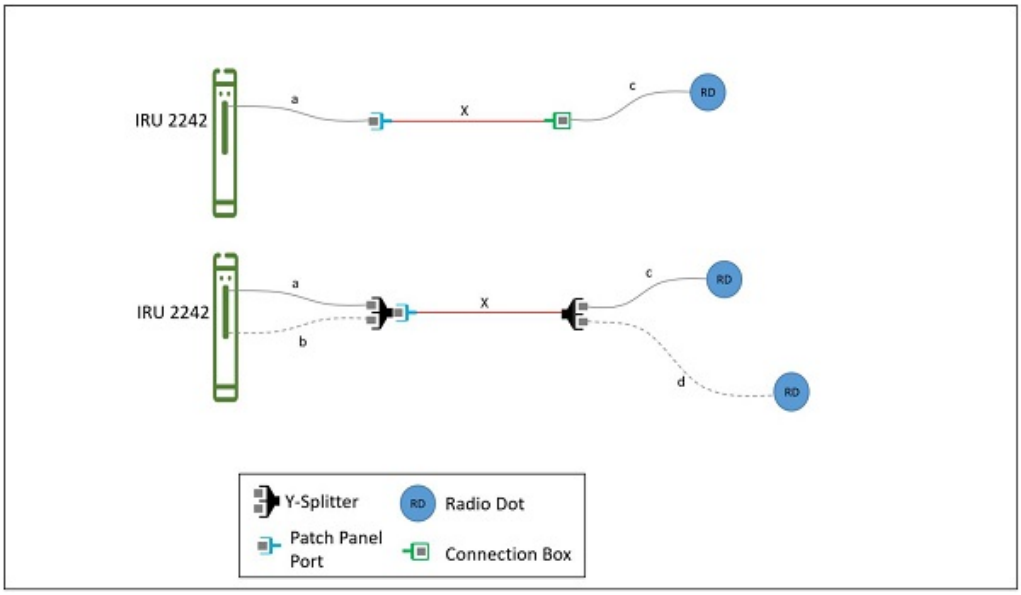
3 RDI Cable Length

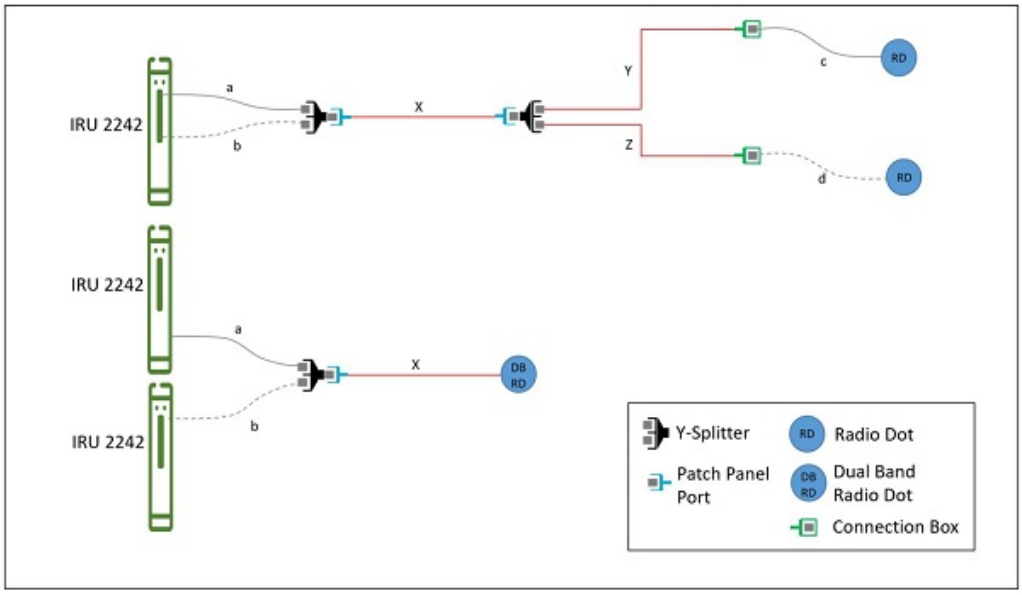
The RDI can be divided into three parts:

— RDI feeder cables - RDI permanent link. Between the patch panel and the connection box (optional)

— RDI patch cables - cables between IRU and patch panel

— RDI jumper cables - patch cables between RD and connection box (optional)





The maximum length of the RDI end to end must not exceed 200 meters. This means that: Patch cable (a and b) + Feeder cable (X, Y, and Z) + Jumper cable (c and d) ≤ 200m. As per the above figure, all the formulas below must be equal or less than 200m:

— a + X + c ≤ 200m

— b + X + d ≤ 200m

— a + X + Y + c ≤ 200m

— b + X + Z + d ≤ 200m

As per the above figure, feeder cable(s) must be tested and certified end to end:

— X

— X + Y and X + Z

Cables, connectors, patch panels, and connection boxes must be compatible with each other.

All cables and installation material recommended for RDS installations are shown in the document *RDS Site Products Overview*, 5/1551-FGB 101 0308/1.

4 RDI Requirements

To ensure full performance of the RDS, cables must be selected, installed, and terminated correctly in accordance with the cable vendor instructions, subject to regional regulations.

It is important that the installed cables meet the RDI Cable Requirements.

Cables recommended by Ericsson are listed in the document *RDS Site Products Overview*, 32/1551-LZA 701 6009/1.

4.1 Generic RDI Cable Requirements

All cables in the RDI channel must fulfill the following:

— Shielded and Screened Twisted Pair (TP) cables must be used to meet cable alien cross talk and regulatory requirements. The following types of shielded or screened TP cables can be used depending on the deployment scenario (see Cable Specific Requirements section in this document):

  - Screened shielded twisted pair (F/FTP, S/FTP)
  - Shielded twisted pair (U/FTP)
  - Screened twisted pair (F/UTP, S/UTP, and SF/UTP)

  Note: /FTP cables are mandatory to be used with the Y-Splitter and Dual band RDs. If the installation is to be used for Dual band RDs in the future, /FTP cables must be used.

— Patch panel is installed according to instructions from the manufacturer with special attention to grounding.

— RDI patch cables and RDI jumper cables, minimum 2 meters* long.

  *This limitation only applies to the link endpoints.

— Total RDI channel (IRU to RD) including patch cables, minimum 20 meters.

— Cable bending radius must be applicable for installation in the RD, see Cable Bending Radius in RD on page 11.

— Connectors are minimum CAT 6, shielded and Power over Ethernet (PoE) compatible.

— Connectors attached to cable conductors in accordance with instructions from the manufacturer with special attention to shielding continuity.

— All cables must follow local fire safety requirements.

— All RDI cables are handled as standard TP cables in case of separation to other cables, as defined in ISO/IEC 14763-2.

— RDI cables are installed separated from sources of electrical disturbance.

  - >100 mm* from electrical cables such as mains power cables and non-power-limited fire alarm circuits

    *100 mm is a typical value. The exact value is calculated based on the cable properties and the cable separation process defined in ISO/IEC 14763-2.

  - >130 mm from lamps

  - >1000 mm from frequency induction heating

4.2 Typical Installation

Typical RDI installations are, apart from the requirements in Generic RDI Cable Requirements on page 8, defined as:

— Total RDI channel (including patch cables and jumper cables) of **up to** 150 meters

and

— Class EA/CAT 6_A cable, according to ISO/IEC 11801, or better

For typical installation, connectivity and shielding testing are mandatory before the system is taken into operation. However, no extra verification on performance is needed.

4.3 Extended Installation

Extended RDI installations are, apart from the requirements in Generic RDI Cable Requirements on page 8, defined as:

— Total RDI distance (including patch cables and jumper cables) **above** 150 meters

or

— Other types of cables than specified for a typical installation.

When selecting cables for extended installations, it is recommended to verify that the cables meet the specifications. This is to ensure full performance in the RDI channel.

4.3.1 RDI Parameters

The RDI must meet the following parameters to ensure full performance of the RDS.

The parameters in Table 1 are for the complete RDI channel (IRU to RD), including patch panels and connectors.

Table 1 RDI Channel Parameters

RDI Parameter(1)	DC	10 MHz	31 MHz	62 MHz	125 MHz	155 MHz	250 MHz
Insertion loss (max.)	–	–	–	30 dB	43 dB	–	63 dB
Return loss (min).	–	22 dB	22 dB	21 dB	18 dB	–	13 dB
Power sum ACR-F (min.)	–	40 dB	30 dB	25 dB	25 dB	25 dB	15 dB
Power sum NEXT	–	–	37 dB	36 dB	34 dB	–	27 dB
DC loop resistance (max.)	39 Ω	–	–	–	–	–	–

(1) Definitions of parameters are found in Definition of RDI Parameters on page 24.

4.3.2 Calculate Maximum Lengths for a Specific Cable

For a particular cable where RDI channel parameter measurements are known, the possible lengths of the RDI depend on the type of cable.

The maximum cable lengths* can be calculated according to the following:

Table 2 Calculation Example

Frequency	62.5 MHz	125 MHz	250 MHz
Insertion loss for selected cable Length = 100 m	15 dB	21.5 dB	31.1 dB
Maximum insertion loss (see Table 1)	30 dB	43 dB	63 dB
Maximum cable length (**Lowest value is used**)	(30 dB /15 dB) × 100 m = **200 m**	(43 dB / 21.5 dB) × 100 m = **200 m**	(63 dB / 31.1 dB) × 100 m = **203 m**

As the lowest value is used, the example gives an allowed maximum cable length of **200 meters***.

*On the assumption that insertion loss is the limiting parameter for the selected cable.

Steps

1. Search for the insertion loss for the selected cable, for example in the product datasheet. The insertion loss is often specified for a cable that is 100 m long.

2. Compare the insertion loss for the selected cable with the maximum allowed insertion loss for the RDI channel in Table 1.

   The values in Table 1 are for the complete RDI channel. Decrease the total insertion loss with the insertion loss for RDI patch cable, RDI jumper cable, and connectors, typically 2 dB. Also consider that the cable insertion loss can vary depending on the ambient temperature.

   For detailed impact of patch cables, jumper cables, and number of mating connectors, refer to the calculation method in ISO/IEC 11801.

3. Calculate the allowed cable length for the specific cable according to the following example.

   The insertion loss is linear in dB as a function of the length.

4.3.3 Cable Bending Radius in RD

The cable bending radius for the RDI cable must be considered for all other cables than the ones listed in *RDS Site Products Overview*, 32/1551-LZA 701 6009/1.

The bending radius depends on the length of the male connector on the cable and on the type of cable. A longer connector requires a sharper bend of the RDI cable. The bending radius is typically 3 times the cable diameter.

Figure 4 shows the RD and the RDI cable connector.

Verify the bending radius with the cable datasheet.

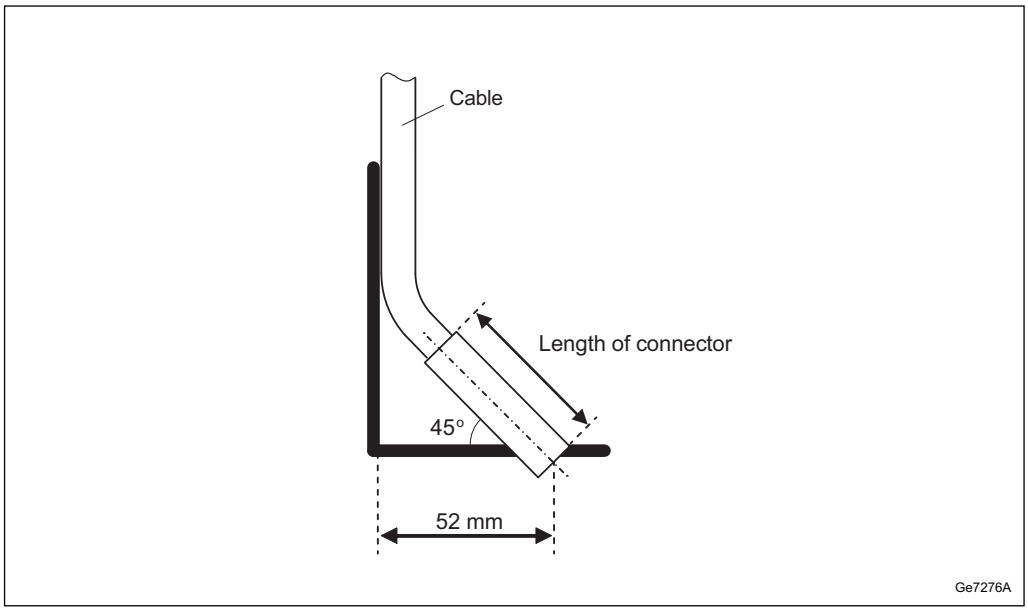


Figure 4 RDI Cable Interface in RD

4.4 Requirements for Building Codes

Some countries have building codes that require specific attributes for cables. The RDI cable, patch cable and jumper cable must respect these codes according to the local or national law. The following are examples of such requirements:

— **Electrical characteristics**: The product requires that certain electrical characteristics be met as described in this document.

— **Local fire codes and building codes**: The local fire codes and building codes must be adhered to depending on the construction of the building, location of the Radio Dots, and the supporting cables. In North America, the National Fire Protection Association (NFPA) 262 is the baseline code that must be met, and UL 2043 is the registration that certifies products as meeting that requirement.

  Note: Some municipalities require practices beyond what is required by the NFPA. Local building codes govern the type, approval, and placement of cables and devices mounted within building structures.

4.4.1 Cables in Air Handling Space

If the cables are to be installed in "air handling space", then the cables must be *Plenum-Rated*, and have the associated UL listing for that certification. The term *Plenum* describes high-temperature-rated products and cable that can be placed within environmental air spaces. Plenum-rated cable is highly resistant to heat and flame spread. Plenum-rated cable is designated in cable specifications by the classification **CMP**.

Riser-Rated Cable is sufficient if the cable installation is NOT in an air handling space, This is designated in cable specifications by the classification **CMR** or **CM**.

4.5 Cables Specific Requirements

For North American installations and locations where building codes are applicable, the selection of the materials need to meet both the electrical and the environmental requirements for installation of the cabling. Select the correct option in the following tables to identify the correct requirements.

Note: /FTP cables are mandatory to be used with the Y-Splitter and Dual Band RDs. If the installation is to be used for Dual band RDs in the future, /FTP cables must be used.

For information on product offerings, refer to RDS Site Products Overview, 5/1551-FGB 101 0308/1.

4.5.1 Feeder Cables

This section defines the requirements for feeder cables.

x/FTP cables are mandatory to be used with the Y-Splitter and Dual band RDs. If the installation is to be used for Dual band RDs in the future, x/FTP cables must be used right away to avoid having to change the cable types.

In each of the categories shown in this table, any types of cable listed can be used.

Table 3 Feeder Cables Requirements

	Y-Splitter	No Y-Splitter
Plenum	U/FTP CMP F/FTP CMP S/FTP CMP SF/FTP CMP	F/UTP CMP S/UTP CMP SF/UTP CMP U/FTP CMP F/FTP CMP S/FTP CMP SF/FTP CMP
Riser	U/FTP CMR F/FTP CMR S/FTP CMR SF/FTP CMR	F/UTP CMR S/UTP CMR SF/UTP CMR U/FTP CMR F/FTP CMR S/FTP CMR SF/FTP CMR
Non-Plenum and Non-Riser	U/FTP F/FTP S/FTP SF/FTP	F/UTP S/UTP SF/UTP U/FTP F/FTP S/FTP SF/FTP

4.5.2 Patch Cables and Jumper Cables

This section defines the requirements for Patch Cables and Jumper Cables.

x/FTP cables are mandatory to be used with the Y-Splitter and Dual band RDs. If the installation is to be used for Dual band RDs in the future, x/FTP cables must be used right away to avoid having to change the cable types.

In each of the categories shown in this table, any types of cable listed can be used.

Table 4 Patch Cables and Jumper Cables Requirements

Y-Splitter	No Y-Splitter
U/FTP	F/UTP
F/FTP	S/UTP
S/FTP	SF/UTP
SF/FTP	U/FTP
	F/FTP
	S/FTP
	SF/FTP

4.6 Installation with Y-Splitter

For Y-splitter deployment requirements and installation procedures, refer to Y-Splitter Guidelines,11/1553-FGB 101 0308/1.

5 RDI Installation

This section gives guidelines on how to install the RDI and other related site products. For Y-splitter deployment configurations, refer to Y-Splitter Guidelines, 11/1553-FGB 101 0308/1.

Exact positions for cable routing and installation of equipment are specific for each site and building. This information is found in the Site Installation documentation or the Installation Specification.

Always follow the installation specification and the installation instructions from the suppliers of the equipment.

Connectors, patch panels, and connection boxes must be of the same type, compatible with each other.

Recommended products are listed in *RDS Site Products Overview*,5/1551-FGB 101 0308/1.

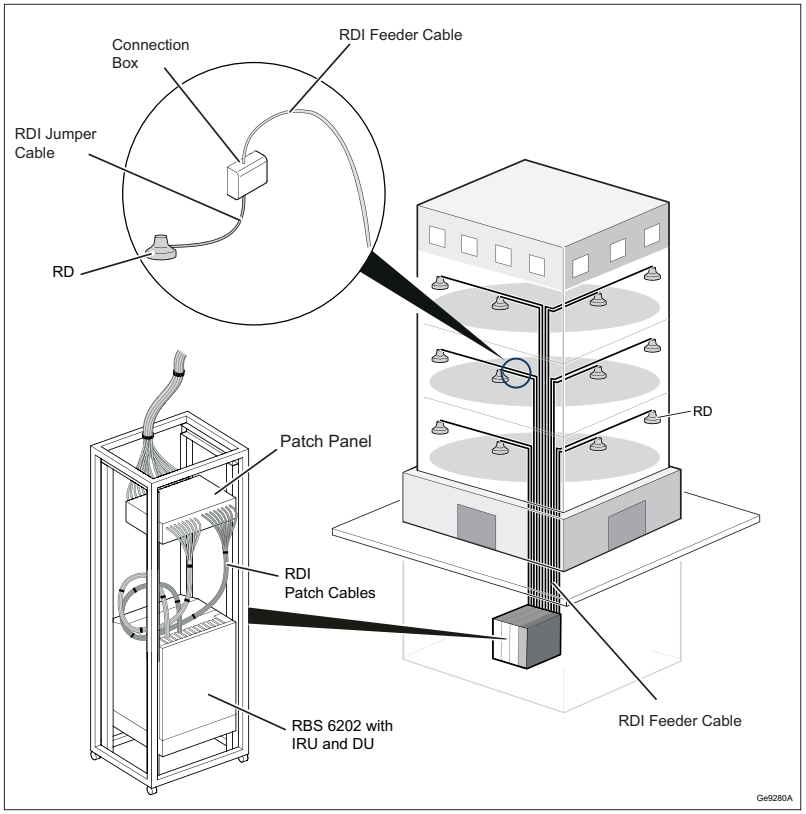


Figure 5 RDI Overview

Handle cables and equipment with care. Do not step on or mishandle the cables in any way during the installation phase, as the performance of the RDS can be affected.

5.1 Route and Prepare RDI Feeder Cables

This section gives an overview on how the RDI feeder cables can be routed in the building.

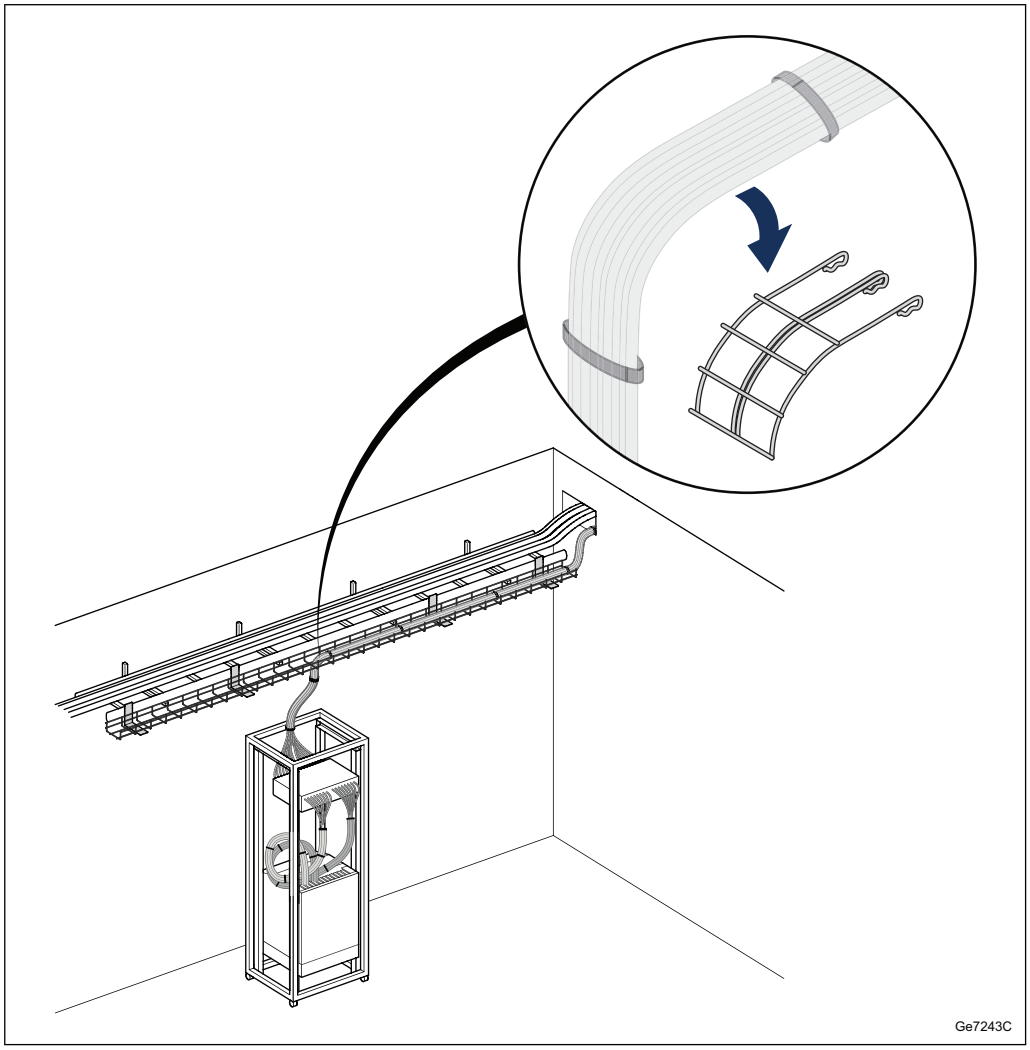


Figure 6 Cable Installation

Steps

1. Route the RDI feeder cables in the building between the IRU and RDs.
2. Install the RDI feeder cables, patch cables, and connectors separated from any sources of electrical disturbance.
   - >100 mm* from cables such as power cables and non-power-limited fire alarm circuits. However, this limitation does not apply to other cables running PoE power distribution.

— >130 mm from lamps

— >1000 mm from frequency induction heating

*100 mm is a typical value. The exact value is calculated based on the cable properties and the cable separation process defined in Installation Standard ISO/IEC 14763-2.

3. For efficient cable routing and installation, the following are recommended:

   — Mark the cables in both ends.

   — Route a bunch of cables in the same direction at the same time, if possible.

   — Keep the cables on the drum when routing to the final destination, if possible.

   — Cut the cables at the final destination to avoid too short cables.

4. Attach RJ45 female connectors in both ends of the RDI feeder cable. Use the same type of wiring (T-568A or T-568B) for all connectors in the RDI.

   Follow the instructions supplied with the connector. Pay extra attention to connect the shield and the ground correctly.

5.2 Connect RDI at the IRU End

This section describes a typical installation with the IRUs inside an RBS 6202 that is placed in a 19-inch rack.

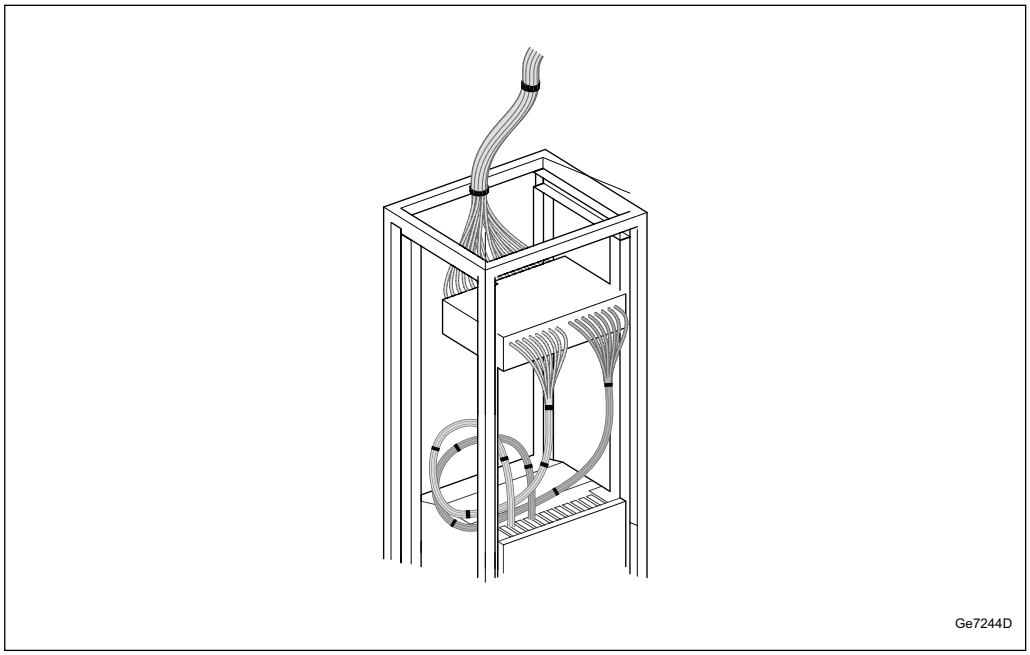


Figure 7 RDI Patch Cable (IRU to Patch Panel)

Note: The RDI endpoint patch cables must be at least 2 m.

To connect the IRU to the RDI feeder cable, do the following:

Steps

1. Install the patch panel in the 19-inch rack.

   Note: Follow the instructions from the manufacturer with special attention to grounding. The patch panel is the grounding point for both the RDI link and the RD.

   Connectors and patch panels must be of the same type, compatible with each other.

2. Attach the RJ45 female connectors (on the RDI feeder cable) to the patch panel.

   Follow the instructions supplied with the patch panel.

3. Connect the IRU patch cables to the female RJ45 connectors in the patch panel.

5.3 Connect RDI at the RD End, with Connection Box (Optional)

This section describes a typical RD installation with two RDs connected to a connection box.

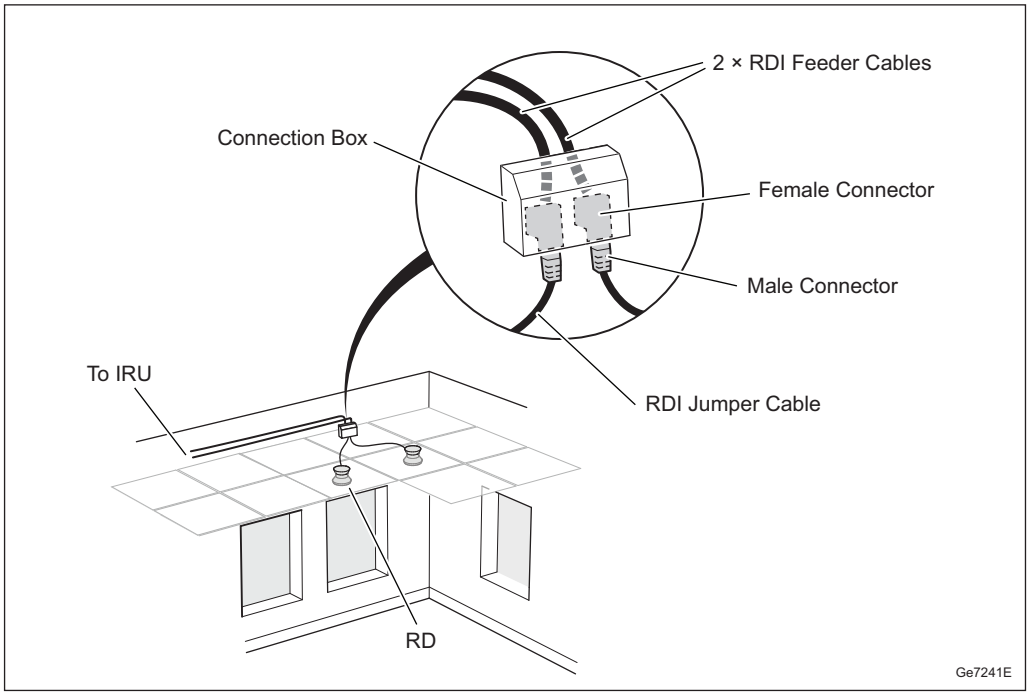


Figure 8 RDI Jumper Cable (RD to Connection Box)

Note: The RDI endpoint jumper cables must be at least 2 m.

To connect the RDI jumper cable, do the following:

Steps

1. Fasten the connection box on a suitable location near the RD.

   To provide for the patch cable slack, the recommended distance between the connection box and the RD is > 0.4 m.

   For standard drop ceiling mounting, it is recommended to fixate the connection box in the plenum space above the suspended ceiling level.

   Follow the instructions supplied with the connection box for fastening instructions.

   Connectors and connection boxes must be of the same type, compatible with each other.

2. Attach the RJ45 female connectors (on the RDI feeder cable) to the connection box.

   Follow the instructions supplied with the connection box.

3. Connect the RDI patch cables to the RJ45 female connectors in the connection box.

5.4 Connect RDI at the RD End, without Connection Box (Optional)

This section describes how to connect the IRU to the RD without connection box.

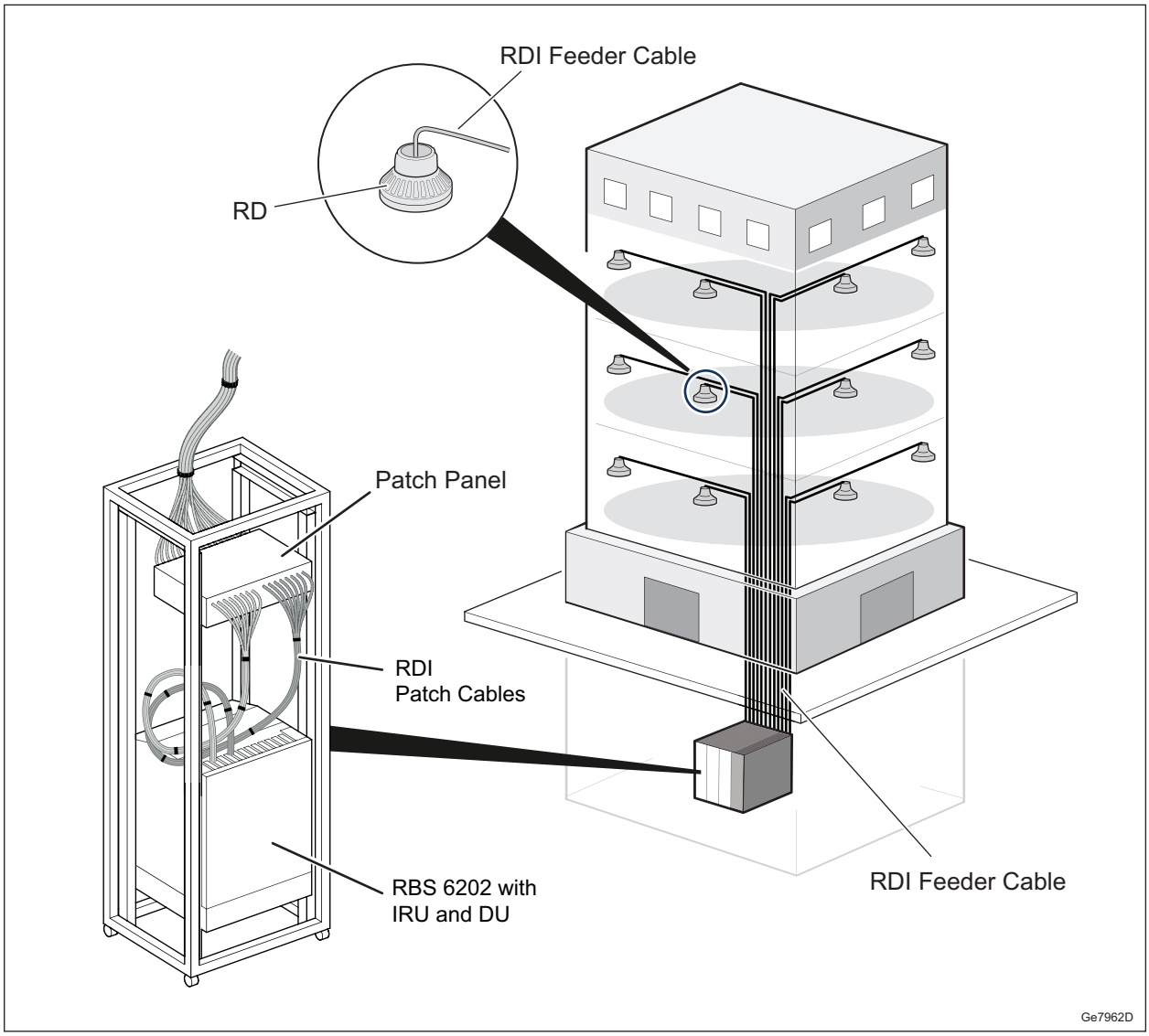


Figure 9 Connect IRU to RD

Steps

1. Route the feeder cable from the IRU to the RD.
2. Cut the cable to the appropriate length.
3. Mount the male RJ45 connector at the RD end of the feeder cable. Refer to *RDS Site Products Overview*, 5/1551-FGB 101 0308/1 for appropriate connectors.
4. Connect the feeder cable to the patch panel.
5. Connect the feeder cable to the RD.

5.5 Connect IRU to RD Without Patch Panel (Optional)

This section describes how to connect the IRU to the RD without the Patch Panel.

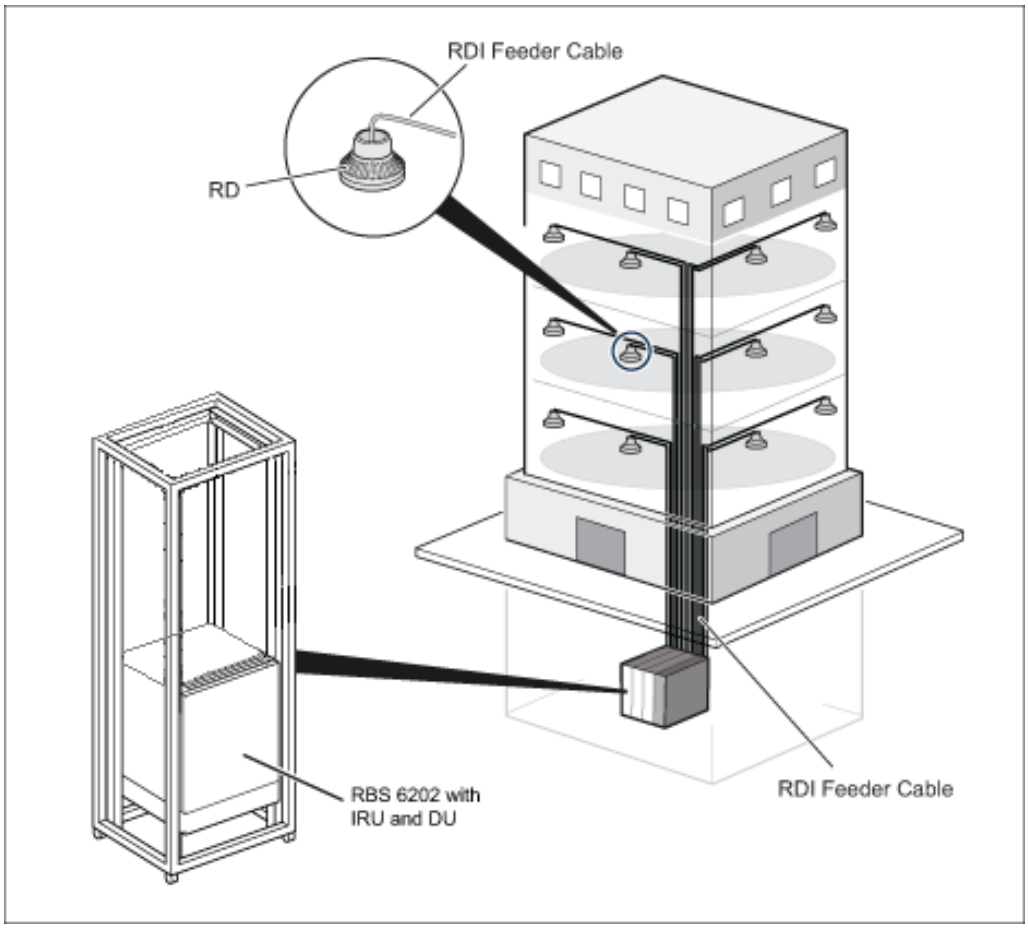


Figure 10 Connect IRU to RD Without Patch Panel

Note: This option can be used only if the Y-splitter is not required.

Steps

1. Route the feeder cable from the IRU to the RD.
2. Cut the cable to the appropriate length.
3. Mount the male connectors on both sides of the cable, according to the information provided by the supplier of the connector. Refer to *RDS Site Products Overview*, 5/1551-FGB 101 0308/1 for the appropriate connectors.
4. Connect the feeder cable to the IRU.
5. Connect the feeder cable to the RD.

6 Test RDI Performance

To ensure full performance test, the RDI channel before the RDS is taken into operation.

Use an applicable test tool capable to test and measure all required parameters. For extended installations, Ericsson highly recommends using a high-end certifier, such as the VIAVI Certifier40G.

The following types of testing are recommended:

— Typical installations (see Typical Installation on page 9), test the connectivity.

— Extended installations (see Extended Installation on page 9), test connectivity, and performance according to the parameters in Table 1.

Follow the instructions supplied with the test tool.

Record and save the test result for future reference.

7 Definition of RDI Parameters

The following parameters are specified for the RDI. Cable pair refers to one of the four twisted cable pairs included in a TP transmission line.

Insertion Loss The decrease in signal strength (attenuation) from one end to the other

Return Loss The ratio of the reflected signal power to the input power

Power Sum (PS) The sum of a level considering all involved cable pairs (for example, sum crosstalk from all three other cable pairs to one cable pair in one TP cable).

NEXT A measure in dB of the unwanted signal coupling from a transmitter at the near-end into neighboring pairs, measured at the near-end. NEXT loss is expressed relative to the transmit signal level.

PS NEXT The sum of the individual NEXT effects on each pair by the other three pairs.

ACR-F Attenuation to Crosstalk Ratio Far End (ACR-F), which compensates for attenuation over the transmission lines by subtracting it from the interfering pair. ACR-F is also known as Equal Level FEXT (ELFEXT).

DC Loop Resistance The resistance between the two conductors of a twisted pair which is looped back at the far end.