Course: Digital Drift System

Module 1.5:

System Design

RFI
TECHNOLOGY SOLUTIONS

Design Considerations – Ethernet over Coax (EoC) RF

The Digital Drift system uses TDD (Time Division Duplexing) to achieve full-duplex communications between nodes on the coaxial cable. Further, timeslots are allocated for each pair of nodes, allowing them to exchange directed packets.

Before getting to the design guidelines, some definitions are required:

DEFINITIONS:

- ***Cable segment:*** A cable segment consists of a series of coaxial cables and Digital Drift nodes that share the same EoC RF spectrum (5 to 200 MHz). Important points:
  - The EoC RF spectrum is blocked from traversing cable segments.
  - A Repeater starts a new cable segment.
- ***Domain Master:*** The Digital Drift node that controls the timeslots on a cable segment is the domain master. There is only one domain master on each cable segment, and it will always be a Portal or Repeater.
- ***Endpoint:*** All Digital Drift nodes attached to a cable segment that are not operating as the domain master are endpoints.
  - A QuadPort always operates as an endpoint.
  - A Portal or Repeater will act as an endpoint if a domain master is already found on the cable segment.

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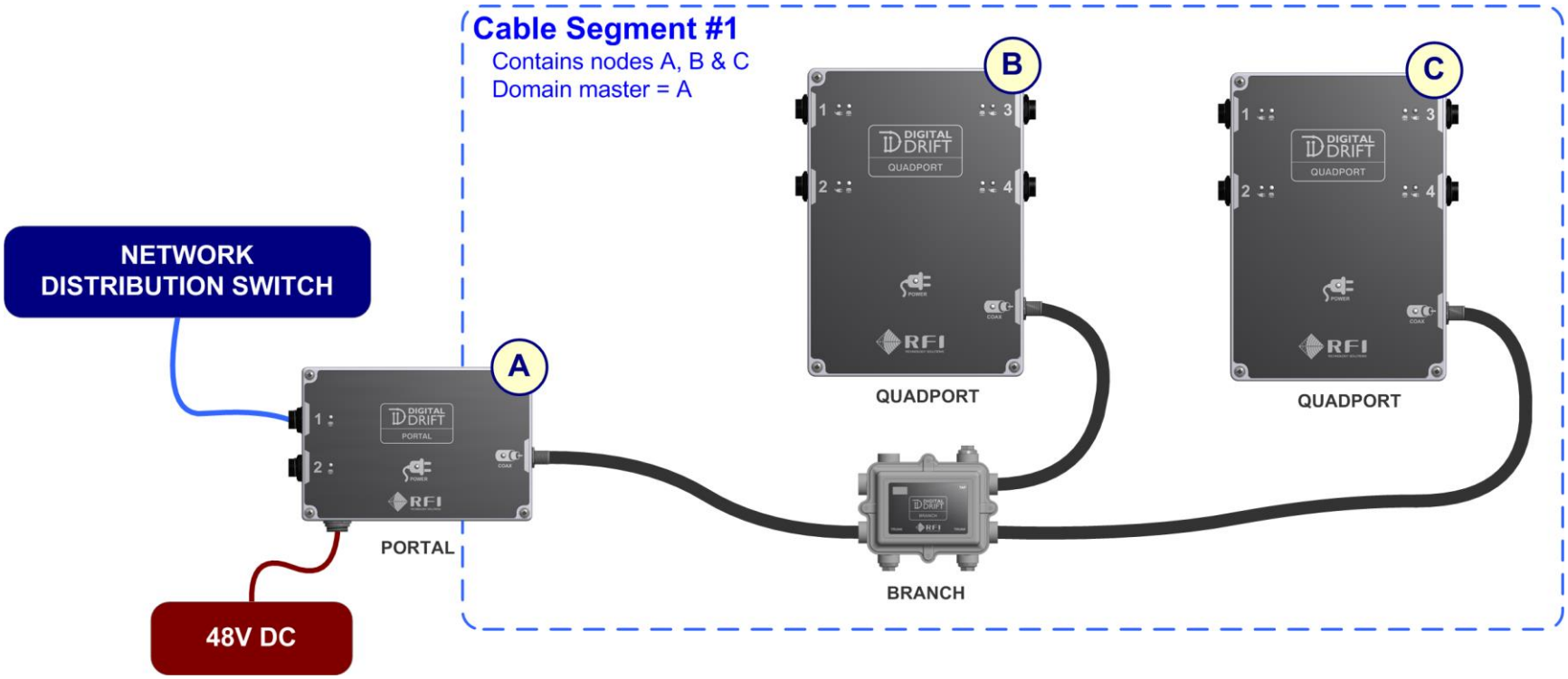
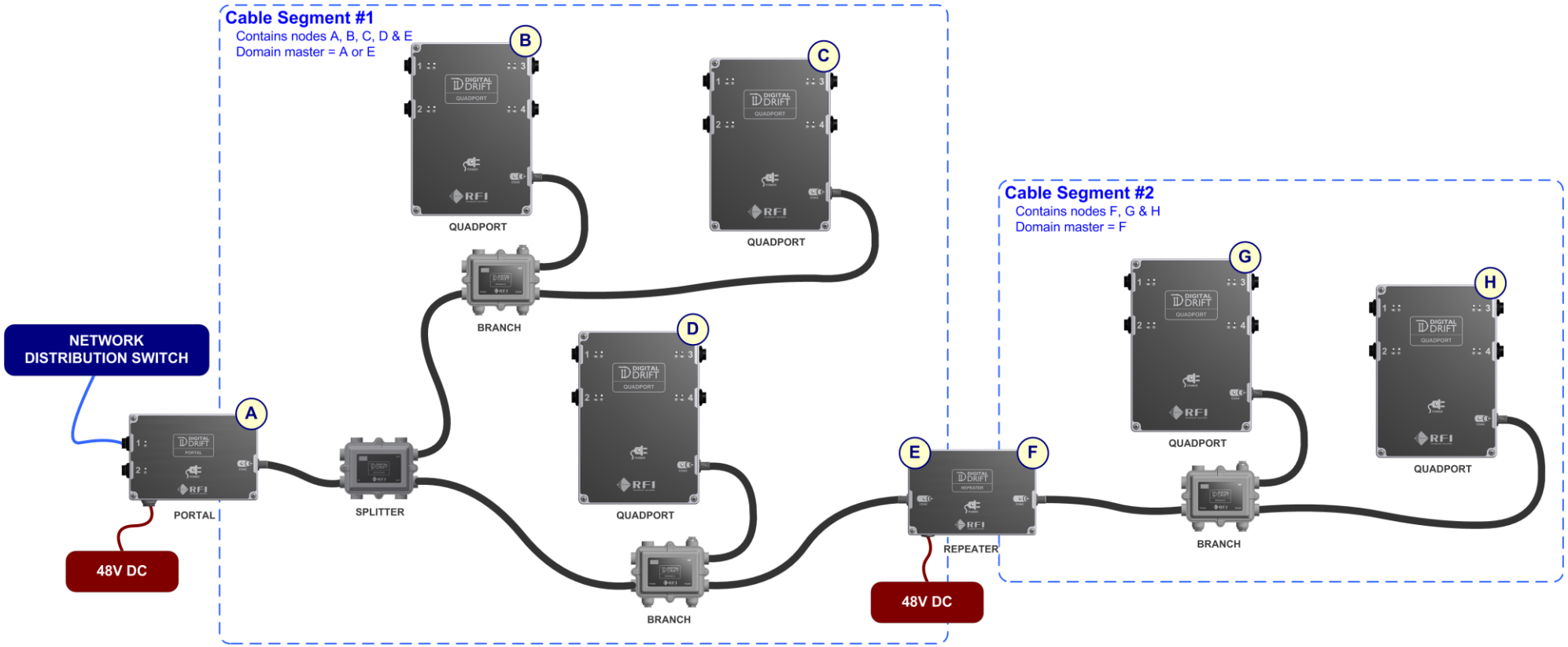
Cable segment examples – Digital Drift original (simple)



Cable segment examples – Digital Drift original (detailed)



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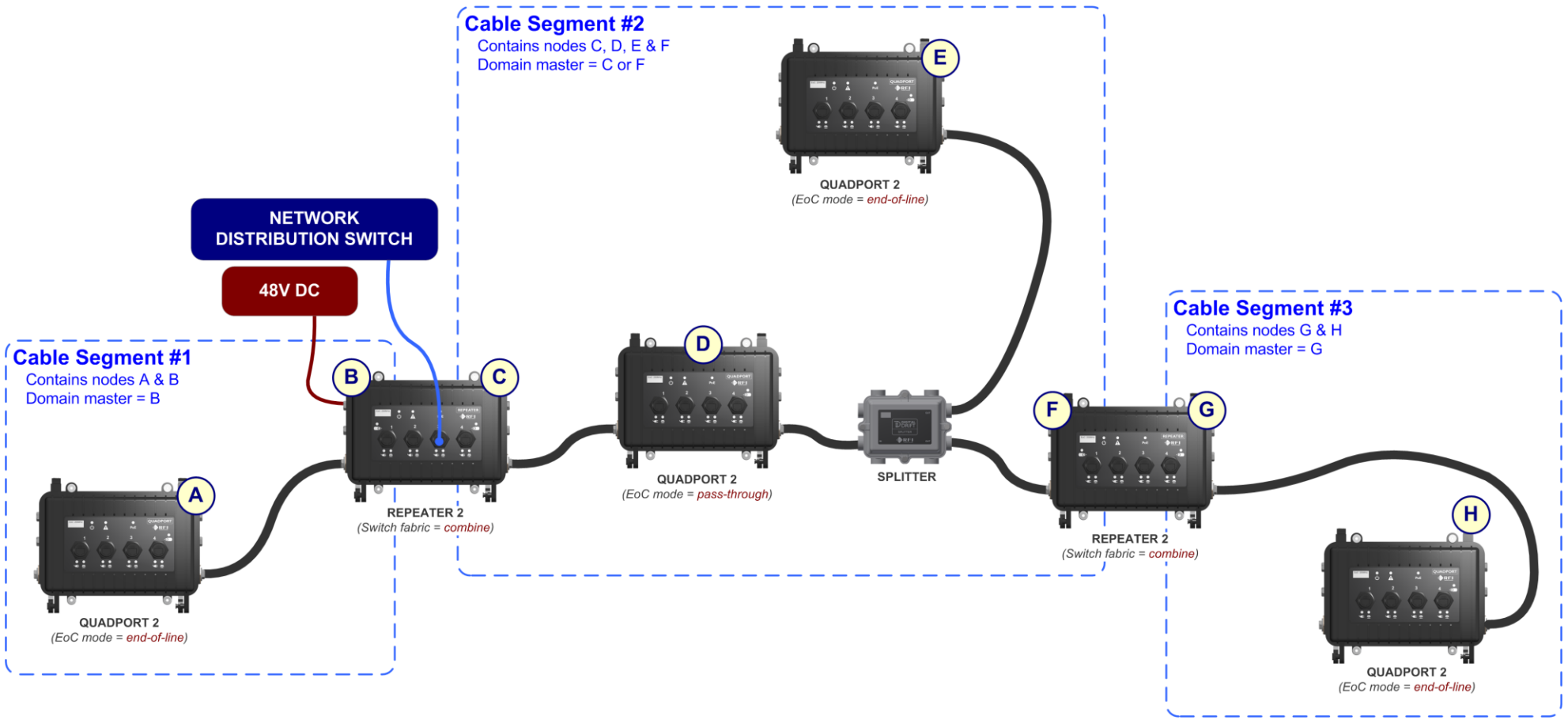
Cable segment examples – Digital Drift v2



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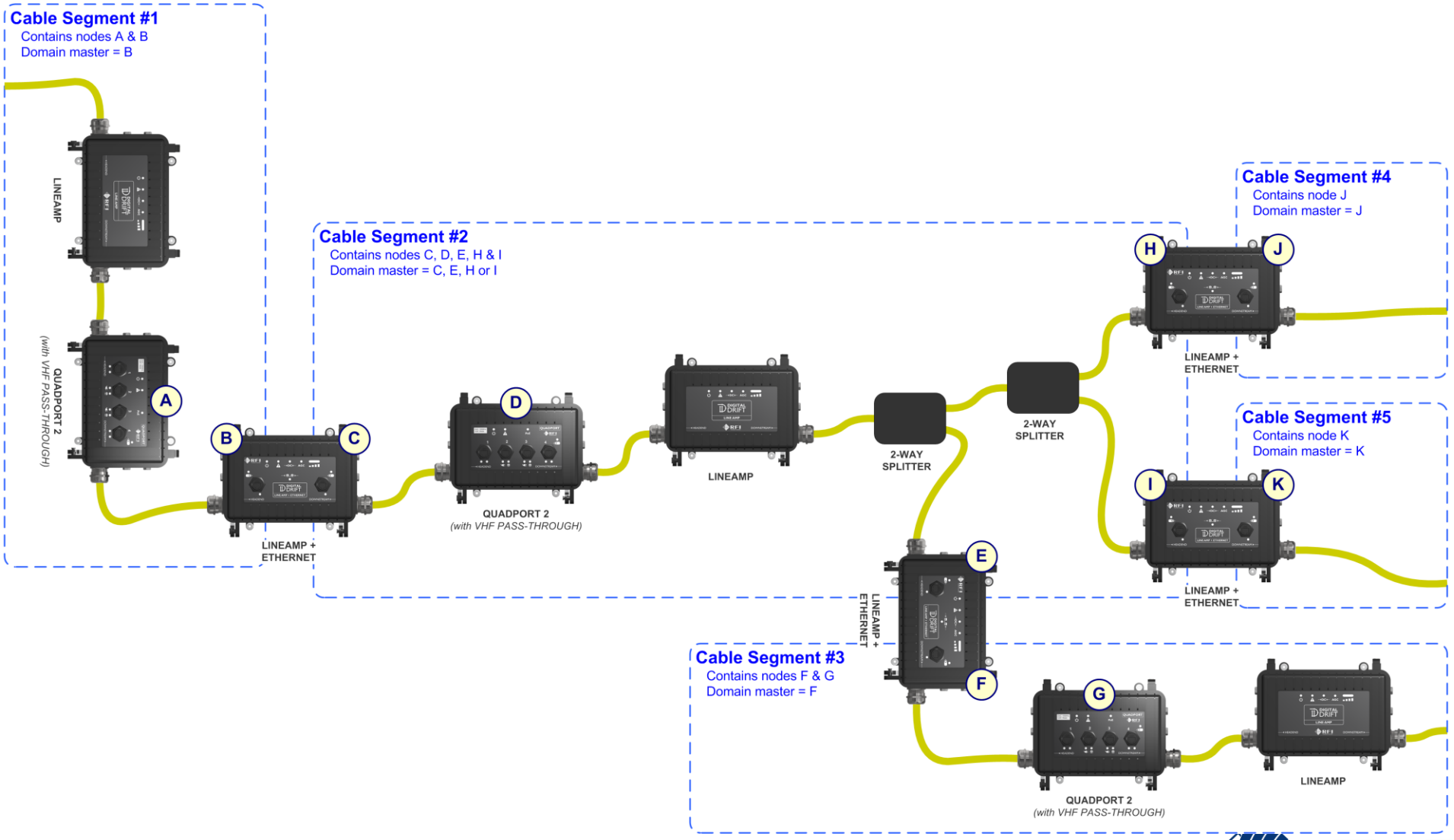
Cable segment examples – Digital Drift Leaky Feeder System



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Design Guidelines

Adhering to the following guidelines will ensure good data throughput from the system.

GUIDELINES:

- Nodes per cable segment = **6 or less**
- EoC RF loss between the domain master and each endpoint = **40 dB or less**
- Cable between any two EoC nodes on the same segment = **1 km or less**

BREAKING THE RULES:

- The system will continue to operate beyond these limits. However, performance will be degraded so please check with RFI technical support before breaking these rules.

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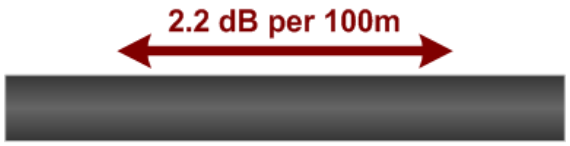
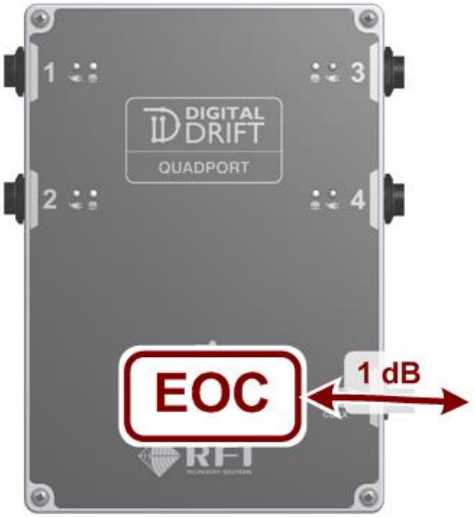
Design Guidelines – Calculating EoC RF loss (Digital Drift original)

The RF loss between any two nodes on a coax segment can be calculated by summing the component losses between them.

SEMI-RIGID CABLE (ULR)

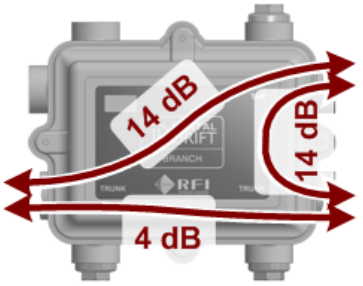


FLEXIBLE CABLE (CF50)



QUADPORT

SPLITTER



BRANCH

PORTAL

REPEATER

RFI TECHNOLOGY SOLUTIONS

Design Guidelines – EoC RF loss example

The RF loss between any two nodes on a coax segment can be calculated by summing the component losses between them.

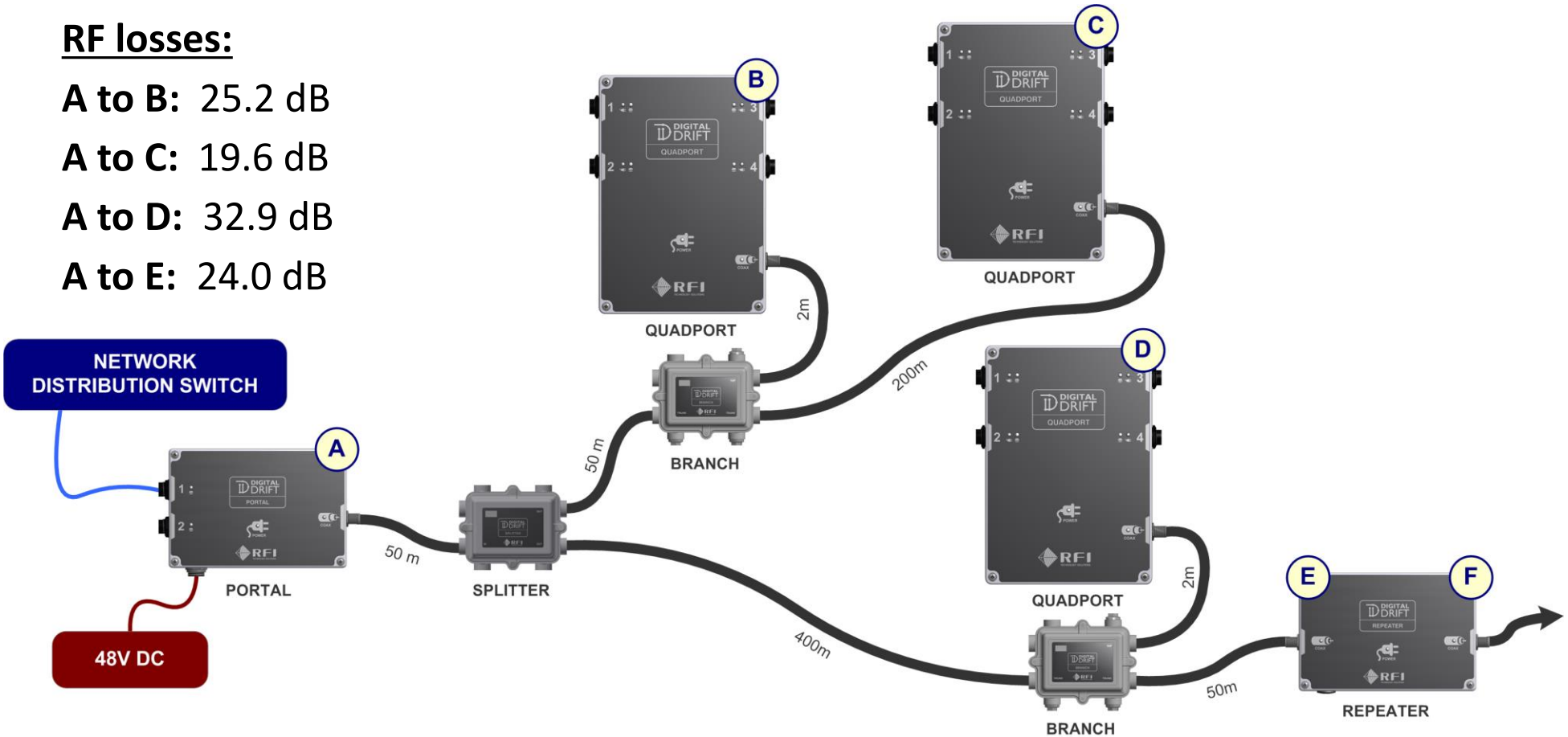
RF losses:

A to B: 25.2 dB

A to C: 19.6 dB

A to D: 32.9 dB

A to E: 24.0 dB



RFI TECHNOLOGY SOLUTIONS

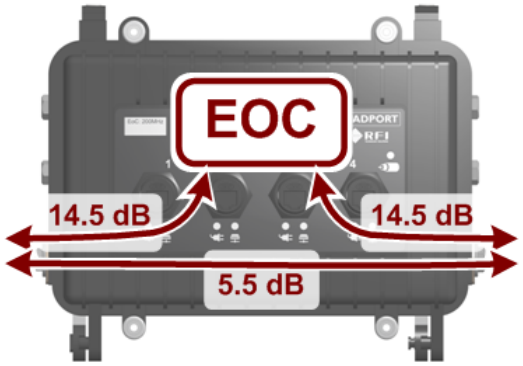
Design Guidelines – Calculating EoC RF loss (Digital Drift v2)

The RF loss between any two nodes on a coax segment can be calculated by summing the component losses between them

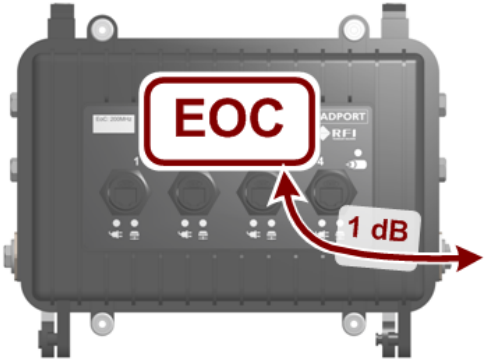
SEMI-RIGID CABLE (ULR)

FLEXIBLE CABLE (CF50)

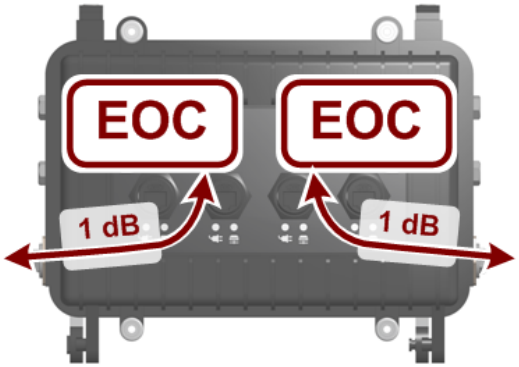
SPLITTER



QUADPORT 2
without VHF pass-through
*(EoC mode = **pass-through**)*



QUADPORT 2
without VHF pass-through
*(EoC mode = **end-of-line**)*

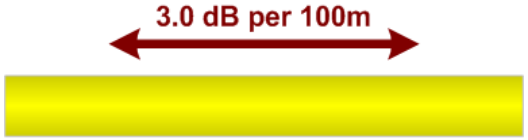


REPEATER 2

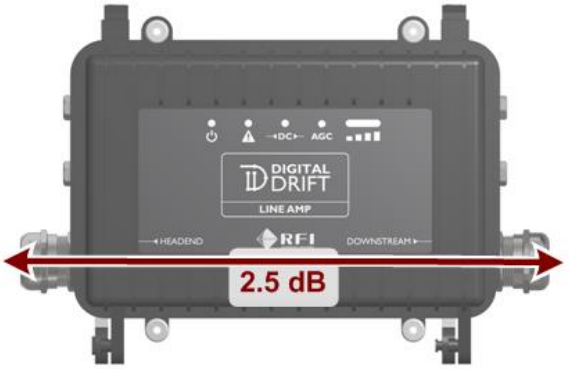
RFI TECHNOLOGY SOLUTIONS

Design Guidelines – Calculating EoC RF loss (Leaky Feeder System)

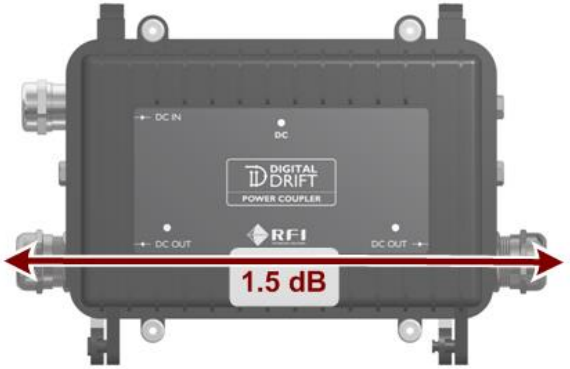
The RF loss between any two nodes on a coax segment can be calculated by summing the component losses between them.



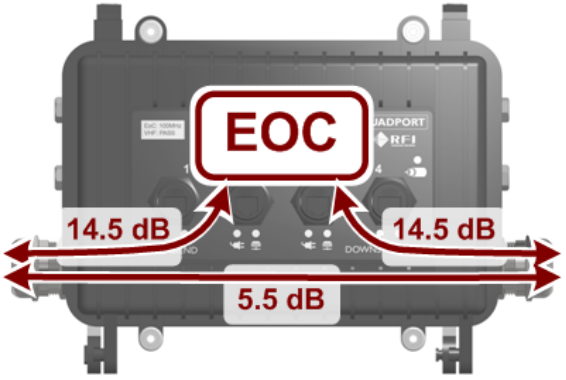
LEAKY FEEDER CABLE



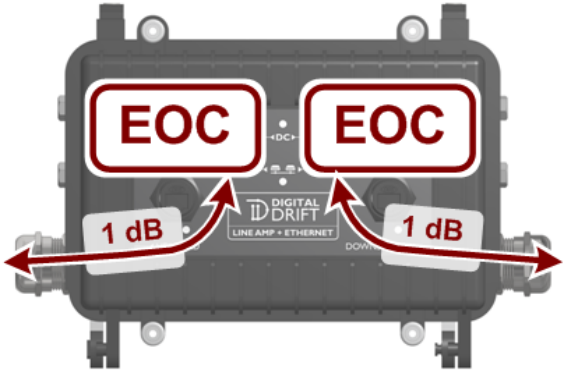
LINEAMP



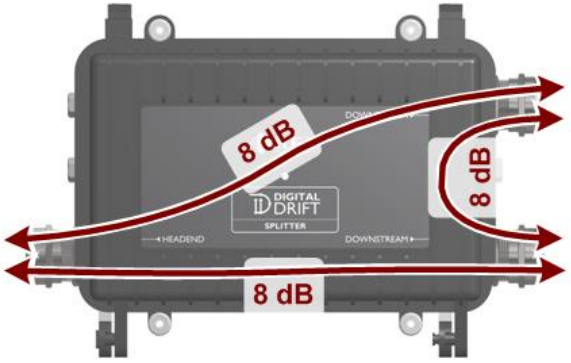
POWER COUPLER



QUADPORT 2
with VHF pass-through



LINEAMP + ETHERNET

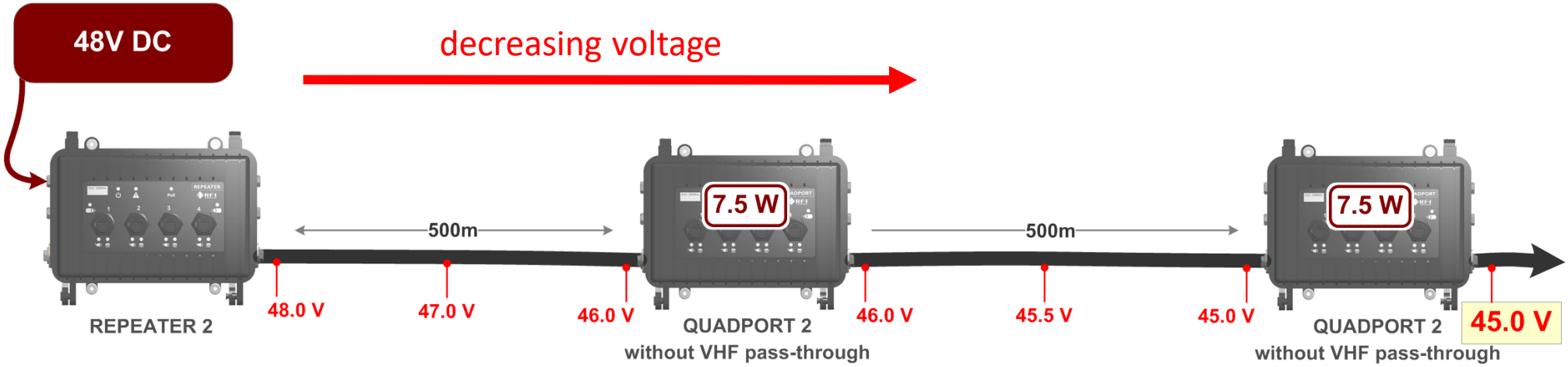


SPLITTER

RFI TECHNOLOGY SOLUTIONS

DC power – voltage drops along the cable

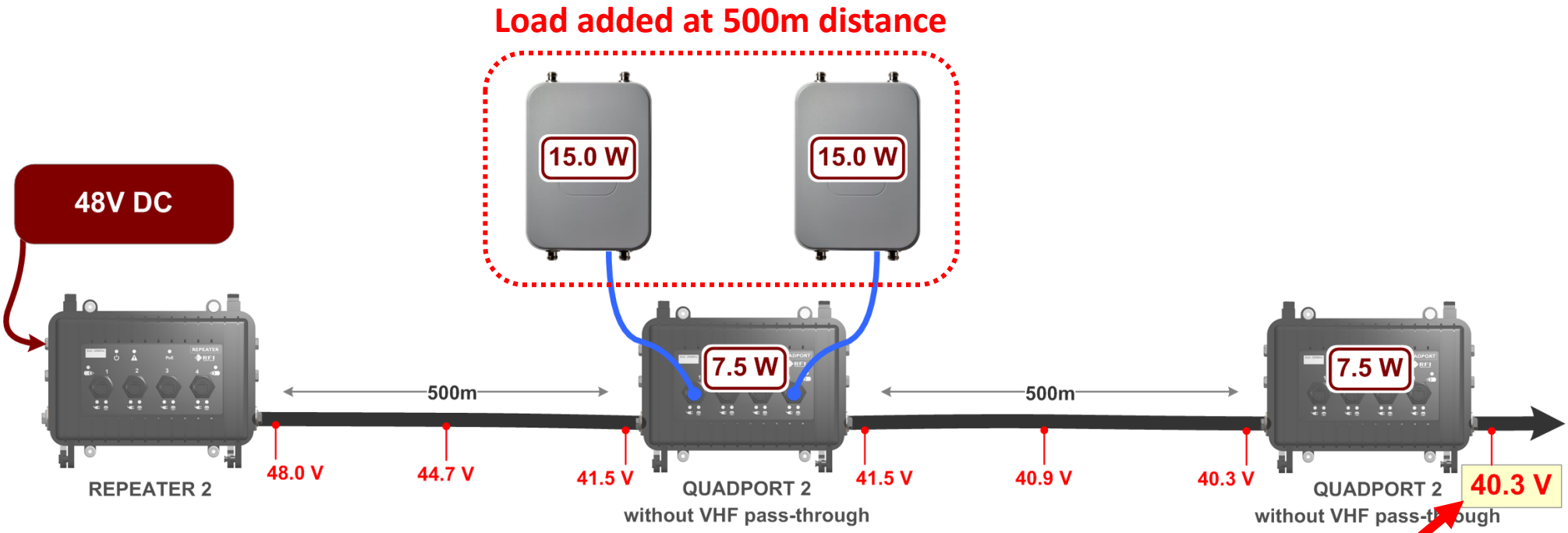
Due to cable resistance, the voltage on the coaxial cable decreases as the distance from the power injection point increases.



RFI TECHNOLOGY SOLUTIONS

DC power – drawing power from the cable increases the voltage drop

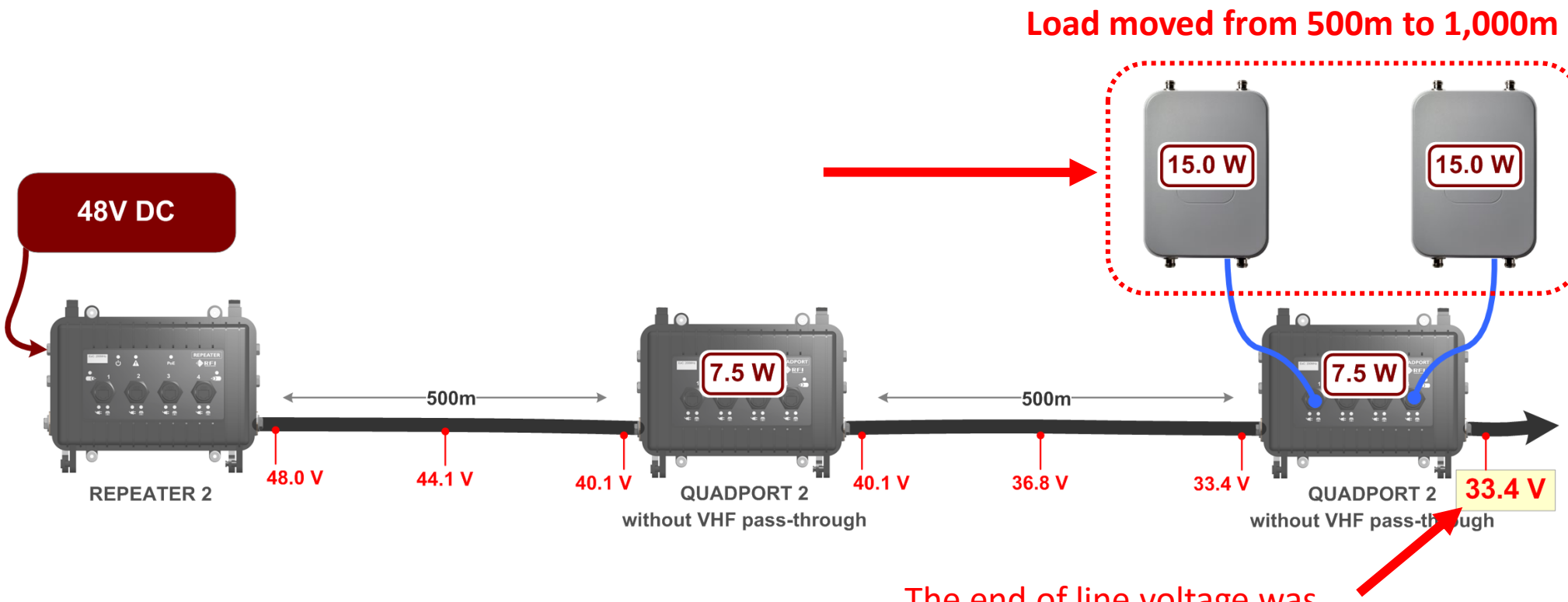
As more power is drawn from the cable, more current flows and the voltage decreases further.



RFI TECHNOLOGY SOLUTIONS

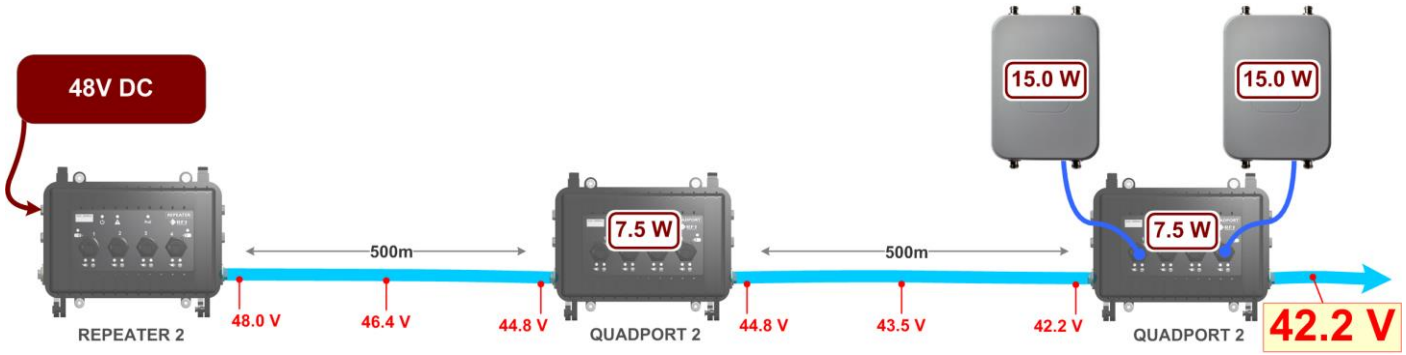
DC power – power drawn further down the cable increases the voltage drop

The further down the cable that the load is located, the greater the voltage decrease.

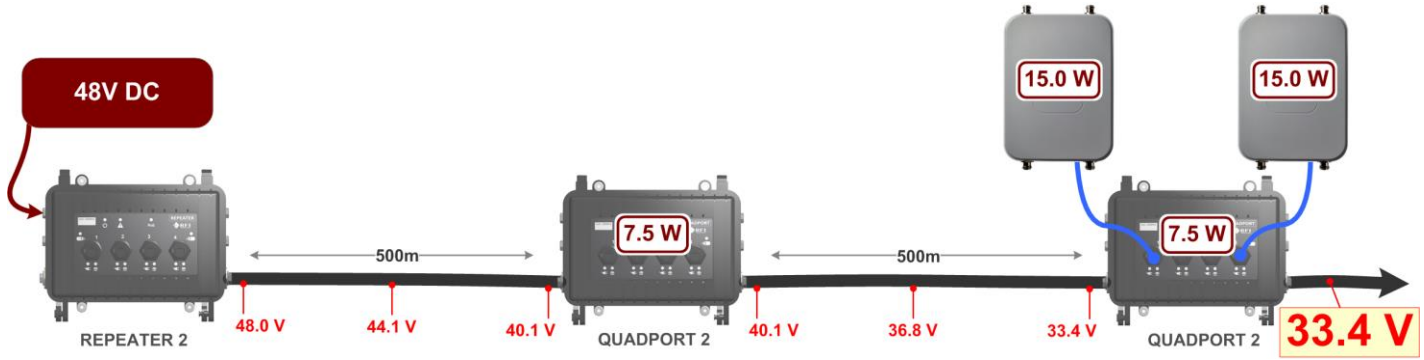


RFI TECHNOLOGY SOLUTIONS

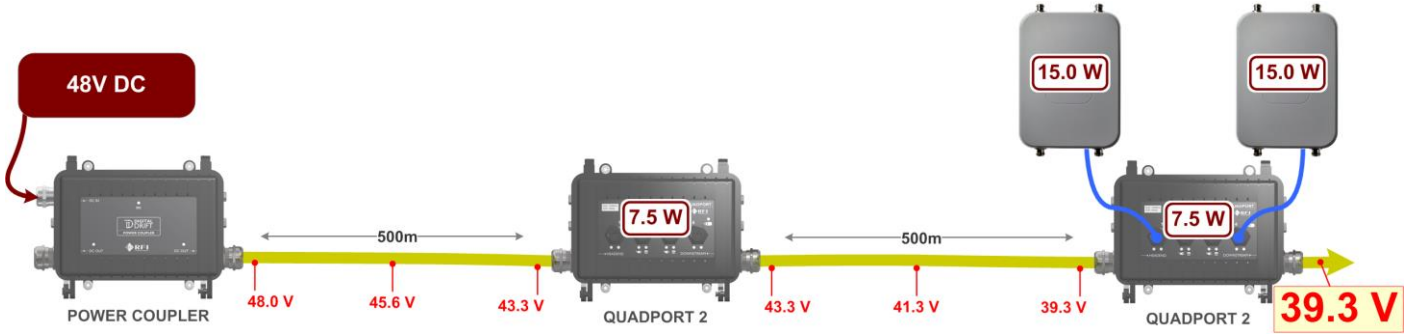
DC power – the higher the cable resistance, the more voltage that is dropped



Semi-rigid coax. (ULR)
6.0 Ohms / km



Flexible coax. (CF50)
12.6 Ohms / km



Leaky feeder
8.6 Ohms / km

RFI TECHNOLOGY SOLUTIONS

DC power modelling

Rule of thumb design guidelines:

- **Semi-rigid coax (ULR) / leaky feeder (yellow):**
  With 48V power injection, up to **1km** range is possible without requiring detailed modelling, even for large loads .
- **Flexible coax (CF50):**
  With 48V power injection, up to **700m** range is possible without requiring detailed modelling, even for large loads.

Detailed modelling tool:

https://adodd.net/tools/voltagedrop-tool/

- Allows user specified loads to be inter-connected with configurable resistances and fed by a user specified power supply voltage.
- The tool displays the voltage expected at each node and the current that will flow in each cable.

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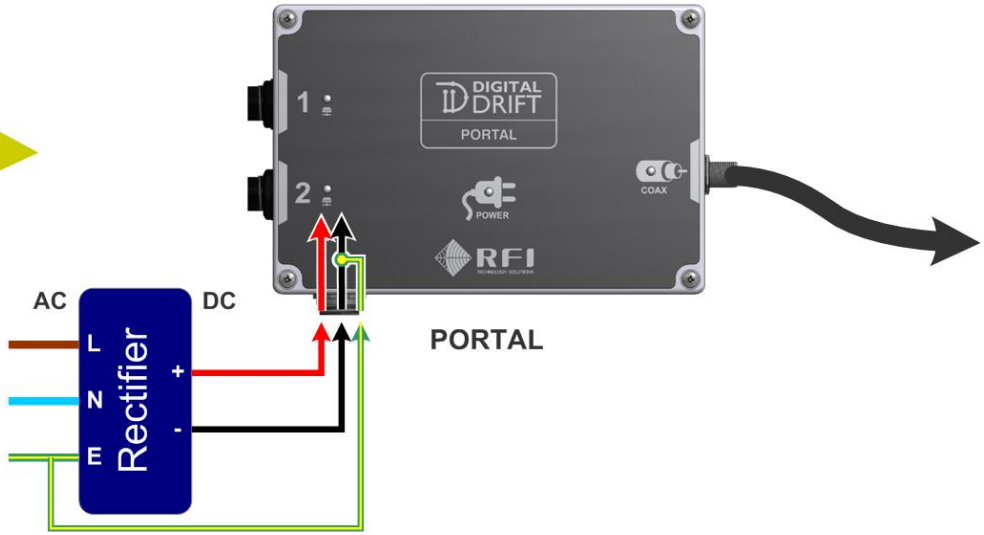
Earthing

Connect EARTH to the DC supply's negative voltage – to stop the coaxial cable shield voltage from floating.

POWER COUPLER



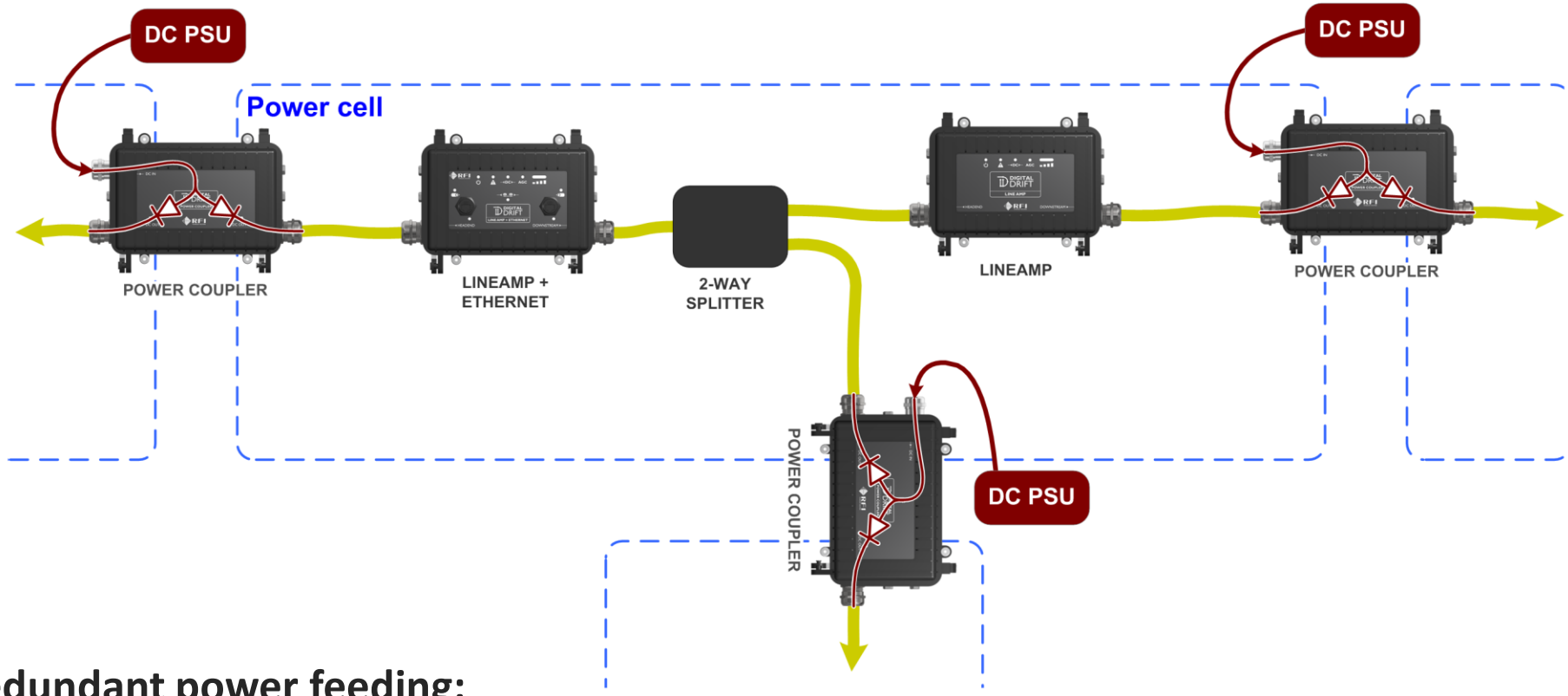
PORTAL

QUADPORT 2 / REPEATER 2

RFI TECHNOLOGY SOLUTIONS

Redundant power feeding

Power can be fed into the cable at multiple locations.



If redundant power feeding:

- RFI Power Couplers can isolate power between adjacent cells.
- Dimension the power cell so that it keeps operating with only active DC PSU.

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