Course: Leaky Feeder System

Module 2.1:

LineAmp Fundamentals
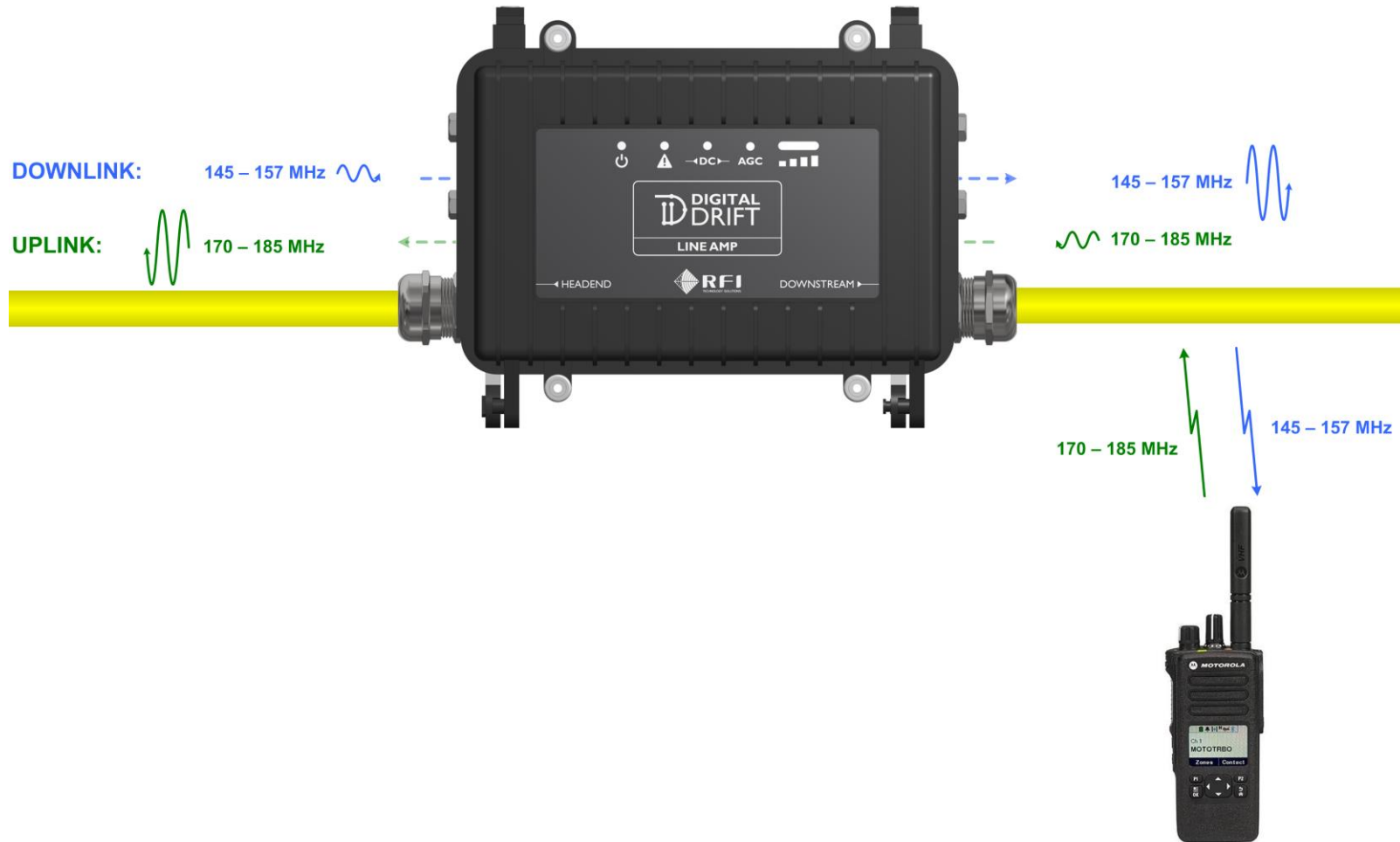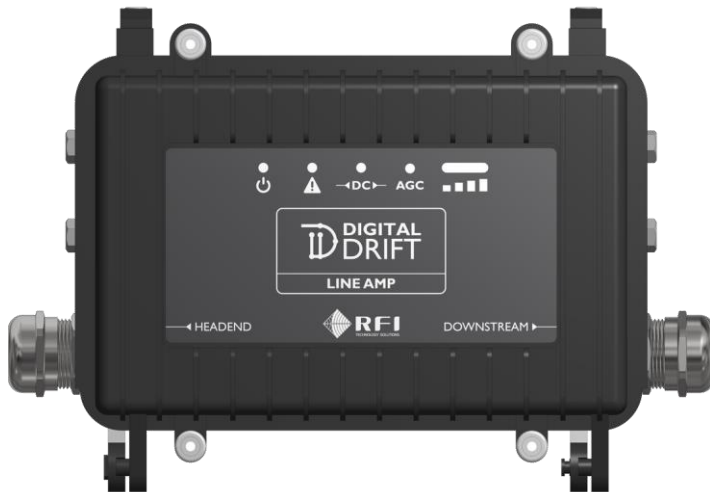
Purpose

To bi-directionally amplify full-duplex VHF radio signals along a leaky coaxial cable.

Differentiators

1. **Superior gain control strategy:** suited to multi-carrier systems

2. **Passes the Digital Drift Signal:** 5 to 98 MHz, enabling high-speed Ethernet over the leaky feeder cable

3. **2-way remote diagnostics capable (*):** with auto topology mapping

(*) The front-end diagnostics platform software is not yet released.

Specifications

| Specification	Value
Operating voltage	10 to 54 V DC
Gain range	10 to 25 dB
Downlink frequency band (*)	145 to 157 MHz
Uplink frequency band (**)	170 to 185 MHz
Impedance	75 Ohm
Power consumption	2.5 W
Ingress protection	IP66
Operating temperature range	-10 to +60 degC
Weight	1.5 kg
Housing	Painted aluminium

(*) There is passband roll-off towards 157 MHz. If a site has downlink carriers near 157 MHz contact RFI technical support to ensure the system design is suitable.

(**) There is passband roll-off towards 170 MHz. If a site has uplink carriers near 170 MHz contact RFI technical support to ensure the system design is suitable.
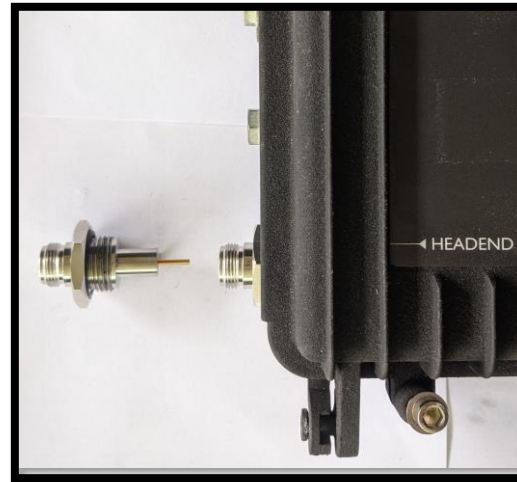
External connections

There are only two external connections – for the LEFT and RIGHT leaky feeder cables

From the factory:
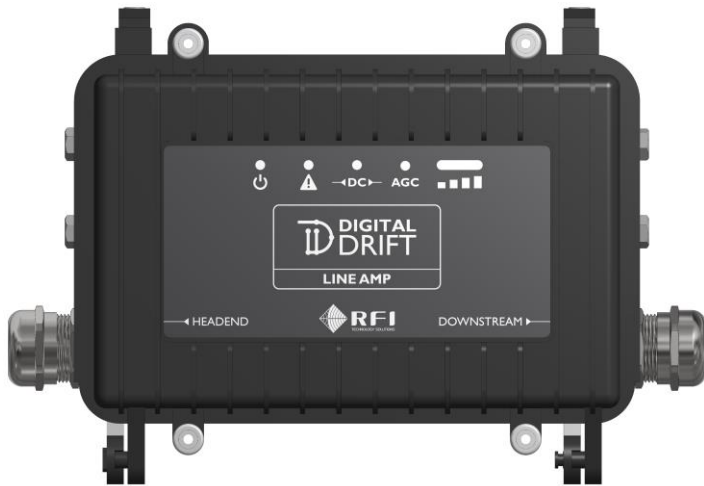
- Designed to accept the standard yellow leaky feeder cable

**Glands can be swapped for DDLFS-NF50-ADPTR:**

- Enables a standard N-Type Female 50 Ohm connection.
- The impedance mismatch is not a problem at the low RF power levels that are used.
- **NOTE:** It is also possible to fit an N-Type Female, 75 Ohm connector, but they are **incompatible** with 50 Ohm N-Type.

In both cases, the device is powered from the leaky feeder cable, using the higher of the voltages on the left or right side

Termination

1. Strip the cable as per the picture
2. Insert the supplied sleeve under the copper strands
3. Insert cable into the board ensuring that:
   - the outer strands all sit under the saddle clamp
   - The centre conductor is fully seated in the gold pin receptacle on the PCB
4. Tighten the external cable gland, as this provides the cable strain relief
5. Tighten the internal saddle clamp onto the outer strands
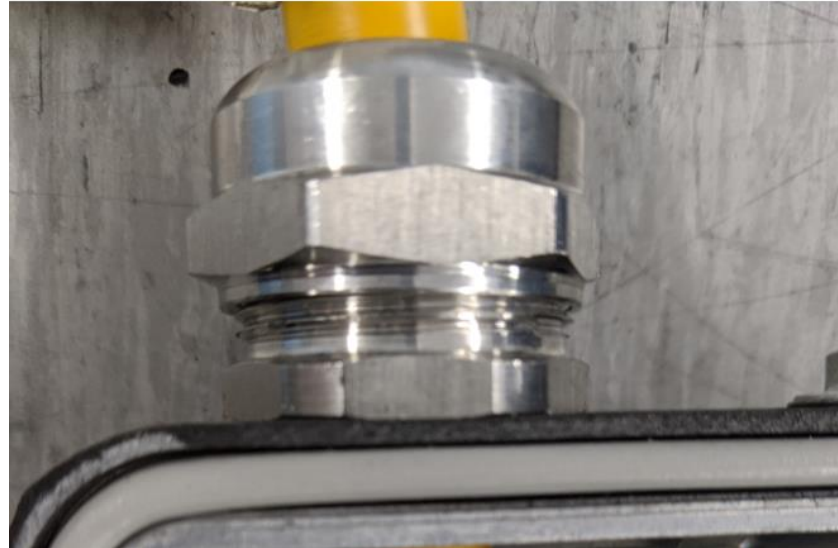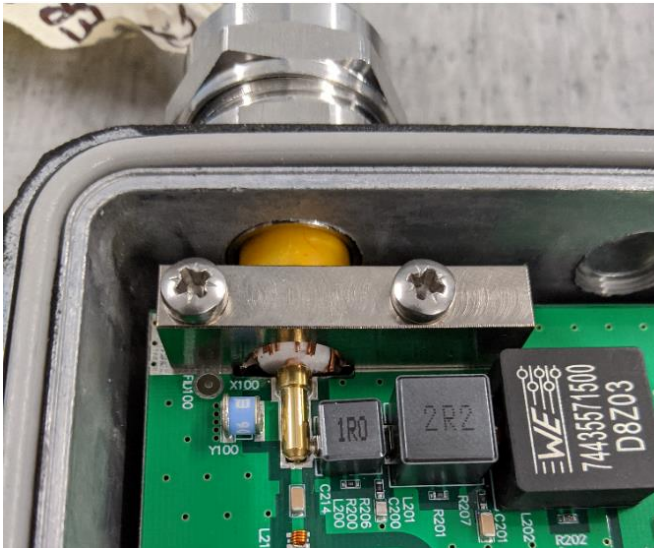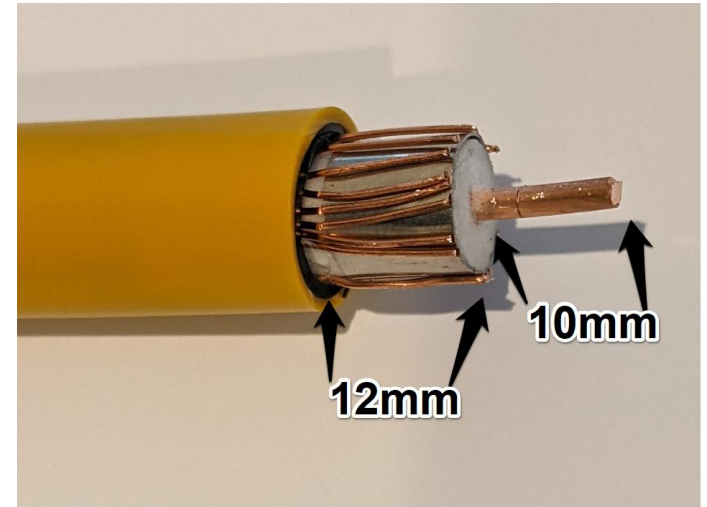
External Indicators

POWER

Off:	No line voltage
Green:	Line voltage above 32 V
Orange:	Line voltage between 20 & 32 V
Red:	Line voltage below 20 V

FAULT

Off:	No faults present
Orange flash (1 Hz):	Minor fault present
Red flash (4 Hz):	Major fault present
Red solid:	Critical fault present
	(return to factory)

DC PASS-THROUGH

Off:	No current flowing
Green:	Current flowing, below 4A
Orange:	Current flowing, between 4 & 8 A
Red:	Current flowing, above 8A

AUTO GAIN CONTROL

Off:	Operating in manual gain control mode
Other:	Depends on the gain control mode
	(refer to the Gain Control training)
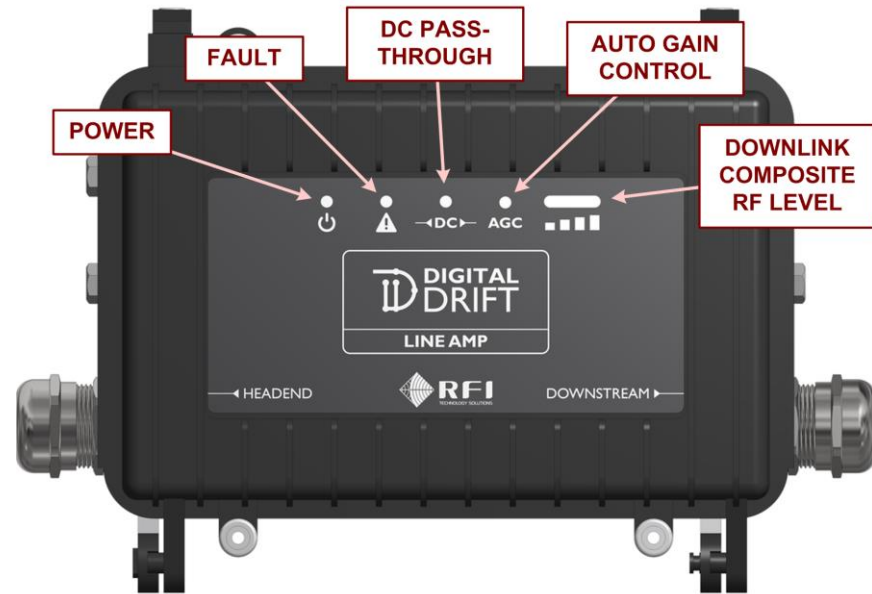
DOWNLINK COMPOSITE RF LEVEL

Off:	Level below –1.5 dBm
1 LED (green):	Level between -1.5 & +2.0 dBm
2 LEDs (green):	Level between +2.0 & +5.5 dBm
3 LEDs (yellow):	Level between +5.5 & +9.0 dBm
4 LEDs (red):	Level above +9.0 dBm
4 LEDs, flashing:	Level above +10.0 dBm
	(Gain limiter is active)

Internals

LINE VOLTAGE
Either:
- Tap line power (max. 2.3A)
- Power this device

GAIN CONTROL
- Set gain control mode
- Observe status
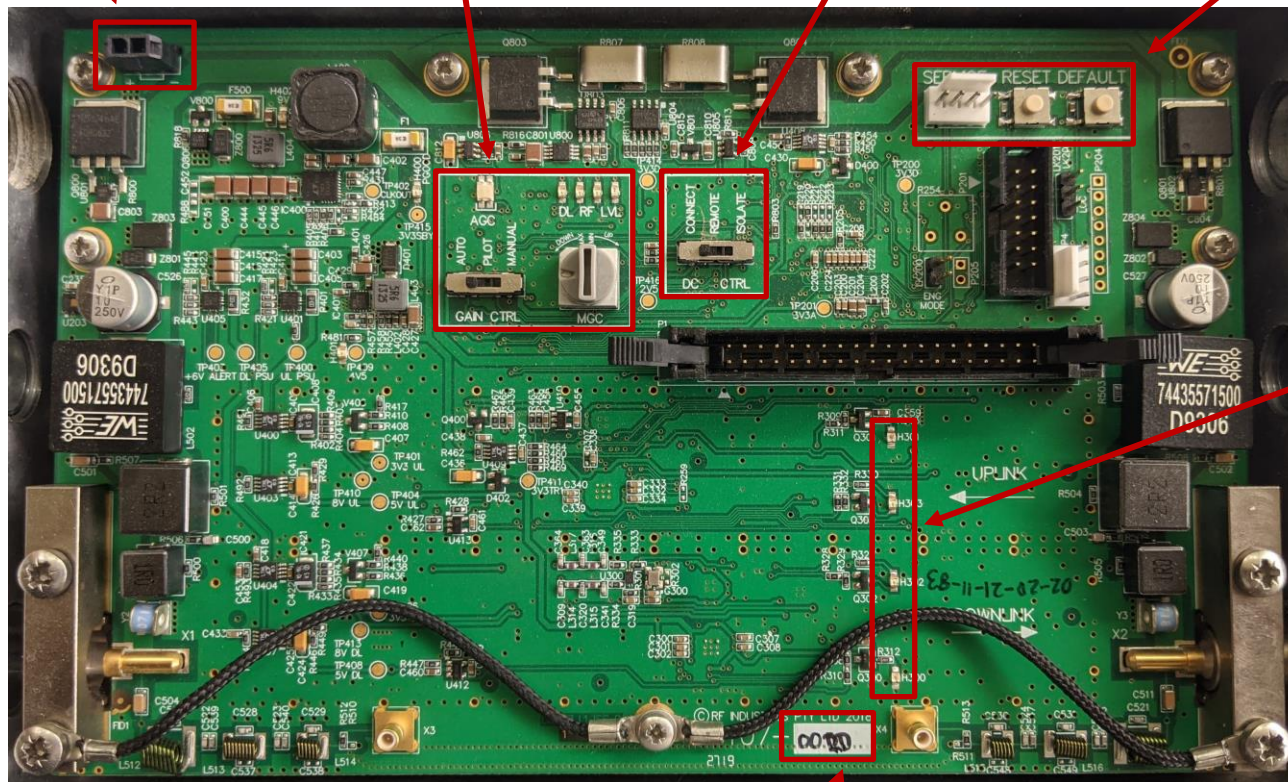
DC PASS-THROUGH
Select either:
- Connect
- Isolate

CONFIGURATION MANAGEMENT
- Serial port CLI
- Soft reset
- Factory Default

2-WAY DIAGNOSTICS COMMS
- Uplink TX (blue)
- Uplink RX (green)
- Downlink RX (green)
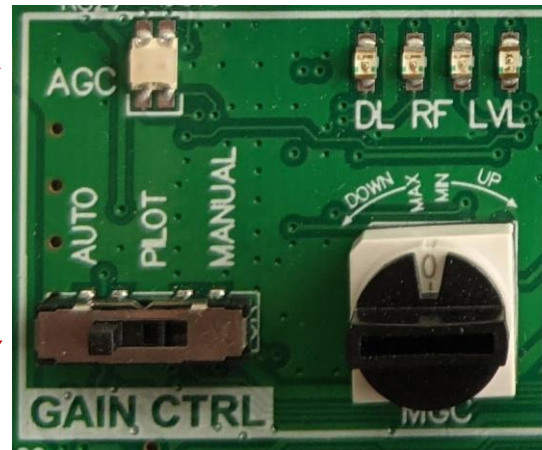- Downlink TX (blue)

HARDWARE REVISION

Internals – Gain control

AGC INDICATOR
Mirrors the state of the external AGC indicator

DOWNLINK RF LEVEL
Mirrors the state of the external Downlink RF Level indicator

MGC
Sets the gain level when operating in manual gain control mode
- Position shown = 10 dB gain
- Each clockwise step adds 1 dB, up to a maximum of 25 dB gain

GAIN CONTROL MODE
Select either:
- **AUTO:** Relies on a GMC at the headend, sending a 'beacon' down the system every second. This mode can only be used if there are no LineAmps performing composite AGC between this device and the headend.
- **PILOT:** Relies on a Continuous Wave (CW) pilot at the headend. This mode applies a learning algorithm to estimate the long-term average composite power at its incoming port and compares that with the 'target' outgoing composite power to set the gain.
- **MANUAL:** Rotate the 'MGC' dial to set the gain.

Internals – DC pass-through

The DC pass-through control depends on the hardware revision

Up to revision E:

- The slide switch controls power transistors that switch power through.
- Do not use the middle position 'REMOTE'.

After revision E:

- Keep it simple:
  - 10A jumper
  - In-line 5 x 20mm fuse

WARNING: When doing live wiring:
1. Place the switch into the ISOLATE position <u>before</u> connecting or removing a cable from the device
2. Move the switch to the CONNECT position after the connections are solid.

Otherwise:
- The power transistors may fail.
- If they fail, the only workaround is to bypass the power transistors by soldering a wire as shown:

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Internals – Configuration

The LineAmp is configured via a Command Line Interface (CLI) over a serial port
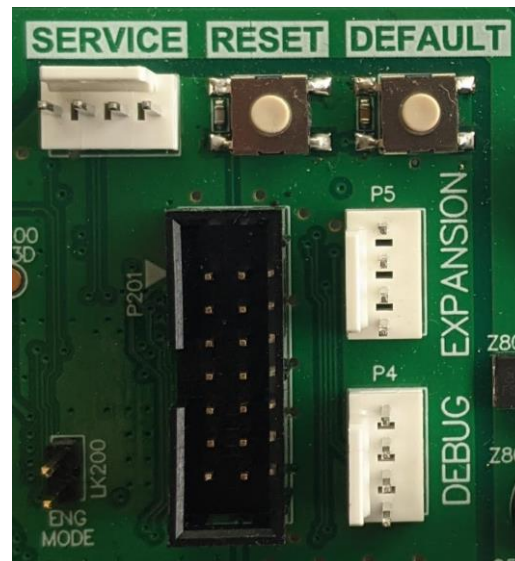
SERVICE
- TTL level UART, used for configuring the device and viewing status

RESET
- Soft reboots the management processor.
- Gain levels are not affected by the reboot

DEFAULT
- Hold for 10s to reset the device's configuration to factory defaults
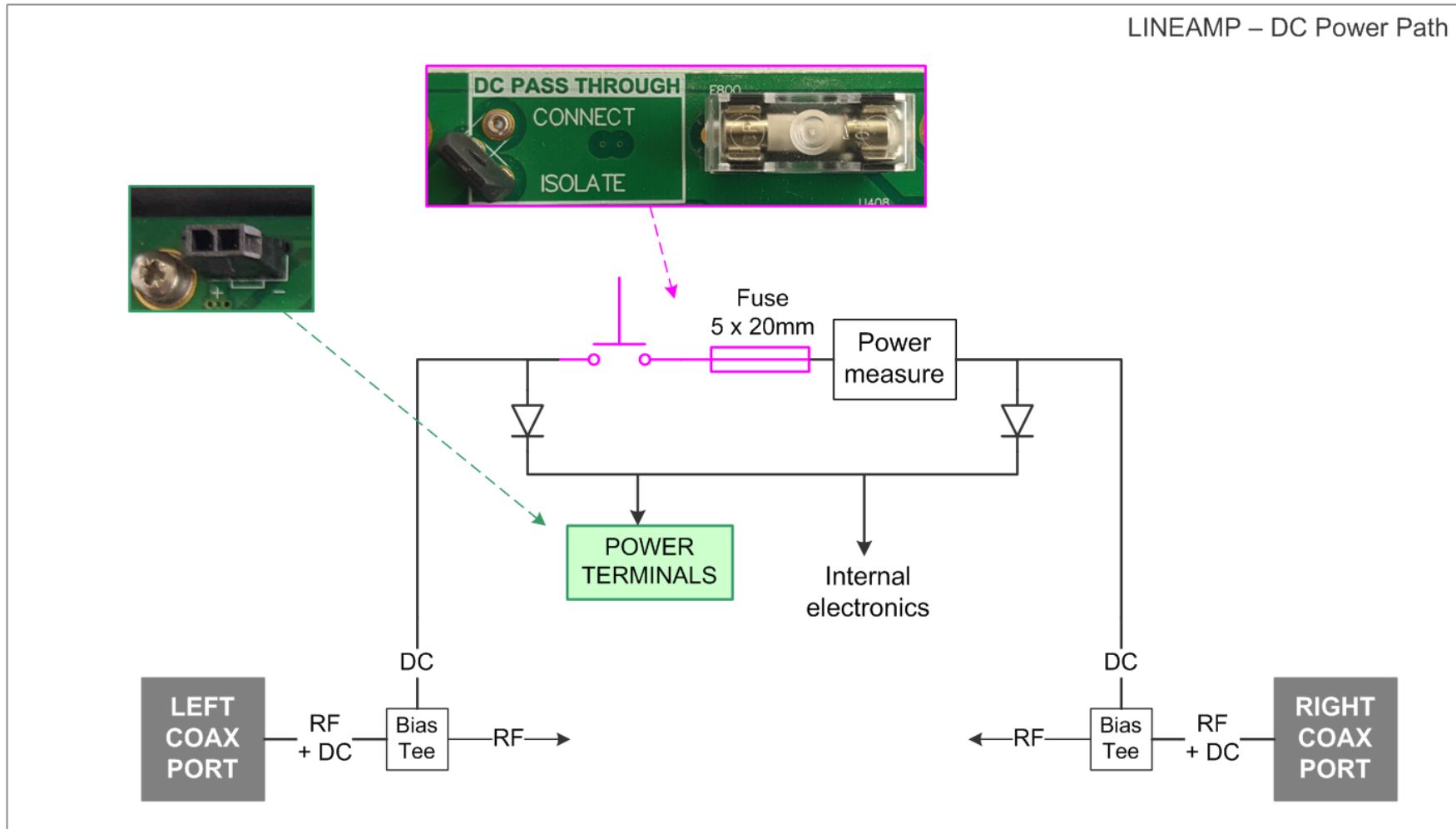
EXPANSION
- Can be used to fit an add-on module:
    - Commtrac gateway
    - Bluetooth
- Only available on hardware revisions after E
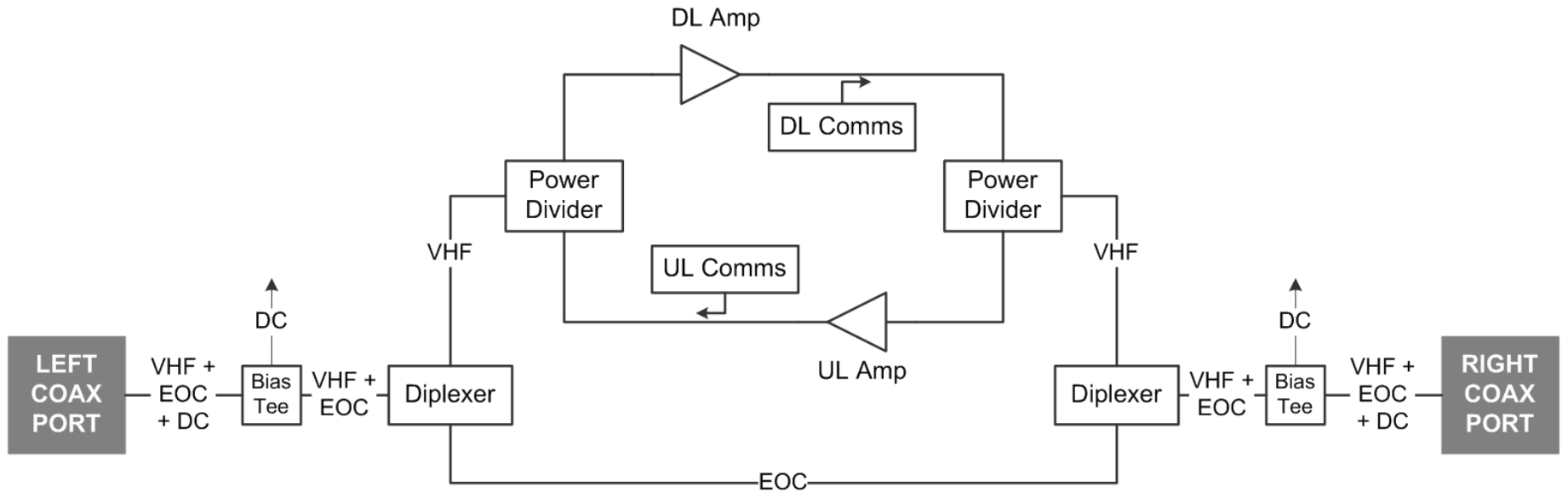
DEBUG
- Not intended for end users

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DC power path

RF path

Installation - Mounting

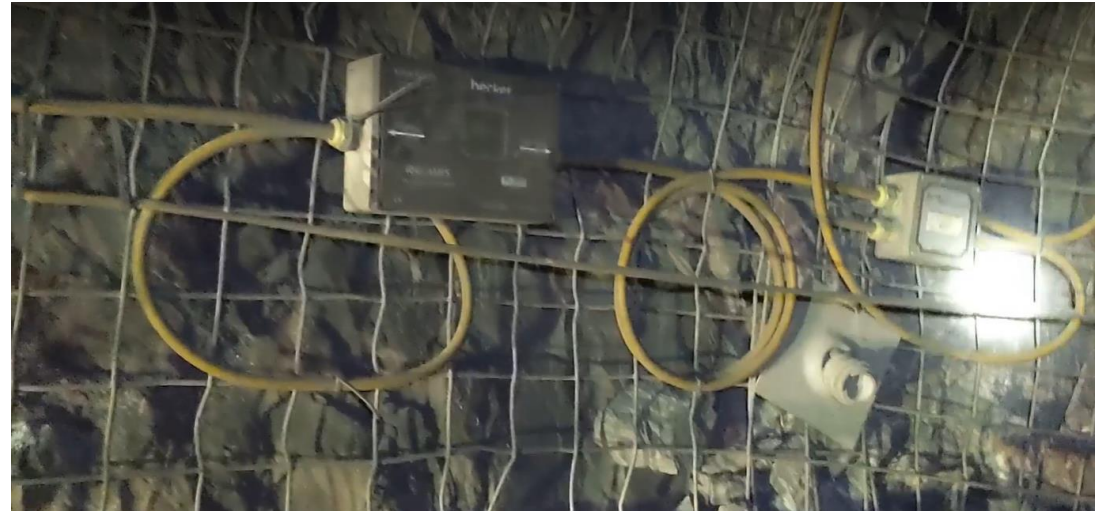- Mounting hooks can be used – each hole has a diameter of 11 mm
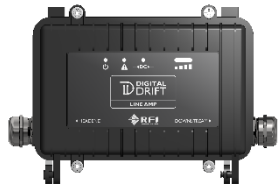
Installation - Cabling

- Avoid headend and downstream cables crossing over each other or running in parallel

- Avoid cable loops right next to each side of a LineAmp

Digital Drift Leaky Feeder System - other devices

LINEAMP

Provides bi-directional amplification of the VHF radio channels, while passing the broadband data signal with minimal loss. The self-adjusting gain algorithm continually adapts to maintain consistent output levels, even as changes are made to the rest of the leaky feeder system.


LINEAMP + ETHERNET

Provides all of the LineAmp features, plus a fully-featured Digital Drift Repeater. This enables:
- Data to be bridged onto and off the cable through the built-in RJ45 ports
- Digital re-generation of the broadband data signal, which ensures high data speeds over the network

POWER COUPLER
- The Power Coupler is used to inject DC power onto the leaky feeder cable.
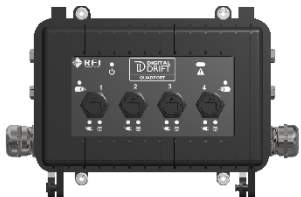
QUADPORT 2, available either:
- **with VHF pass-through**: an in-line device that can be spliced into the VHF leaky feeder system's cable to break out four PoE++ ports. This takes the place of an Ethernet Coupler + QuadPort v1 when breaking out PoE ports from the Leaky Feeder System.
- **without VHF pass-through**: replaces the Branch + QuadPort v1 from the existing "data-only" Digital Drift System.

GAIN MANAGEMENT CONTROLLER (GMC):
- Automatic gain control
- Diagnostics interface - Future