REVISION GUIDE

Free-Space Path Loss and Link Budget Revision Pack

A stronger revision pack for free-space path loss, received power, link accounting, and the practical dB habits that turn path numbers into usable RF planning decisions.

QUICK OVERVIEW

Category: rf radar communications

Includes 2 related guide pages.

Links back to 4 calculator tools.

FORMULA HIGHLIGHTS

FSPL

FSPL(dB) = 20 log10(d) + 20 log10(f) + constant

Budget pattern

received power = transmit power + gains - losses

WHAT THIS PACK COVERS

This pack ties together free-space path loss, received power, fade margin, and hardware losses so the propagation and system sides of a link can be read as one story.

CORE FORMULAS

- FSPL(dB) = 32.44 + 20log10(dkm) + 20log10(fMHz)
- Pr = Pt + Gt + Gr - FSPL
- Received power = source terms + gains - all losses
- Fade margin = received power - receiver threshold

HOW TO READ THE DB BOOKKEEPING

- Path loss is a propagation term, not a cable term.
- Antenna gain, feeder loss, and connector loss should each stay visible as separate budget terms.
- A positive-looking budget is not the same thing as comfortable margin.

WORKED EXAMPLE: FIRST-PASS PATH LOSS

A 2.4 GHz link over 5 km has free-space loss of roughly 114 dB. That is a normal RF-scale number and only becomes meaningful when combined with the rest of the system terms.

WORKED EXAMPLE: BUDGET AND MARGIN

A 20 dBm transmitter, 18 dBi antennas at each end, and 114 dB path loss give a first-pass received power near -58 to -60 dBm depending on the implementation losses included. Comparing that result against receiver threshold reveals the useful margin.

COMMON MISTAKES

- Mixing units and constants in the path-loss formula.
- Hiding cable or connector losses inside the propagation term.
- Comparing received power against the wrong threshold or data mode.
- Ignoring fade margin when deciding whether the link is robust.

BEST OFFLINE USE

Use this pack for quick RF planning, revision, and sanity checks before moving into detailed deployment assumptions or site-specific propagation modelling.