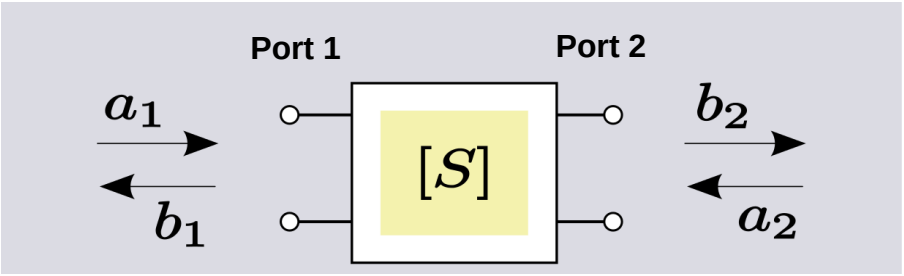
# Comparison of 10 amplifiers

- RF (radio freq.) amplifiers: kHz - GHz
- Characterized by VNA (vector network analyzer)
  - ➔ Amplitude & phase properties
- Characteristics captured in '**S**cattering parameters':




S-parameters in a two-port network

Credit: User:Spinningspark, Filelink: Two-port_S-parameters.svg

Reflected waves

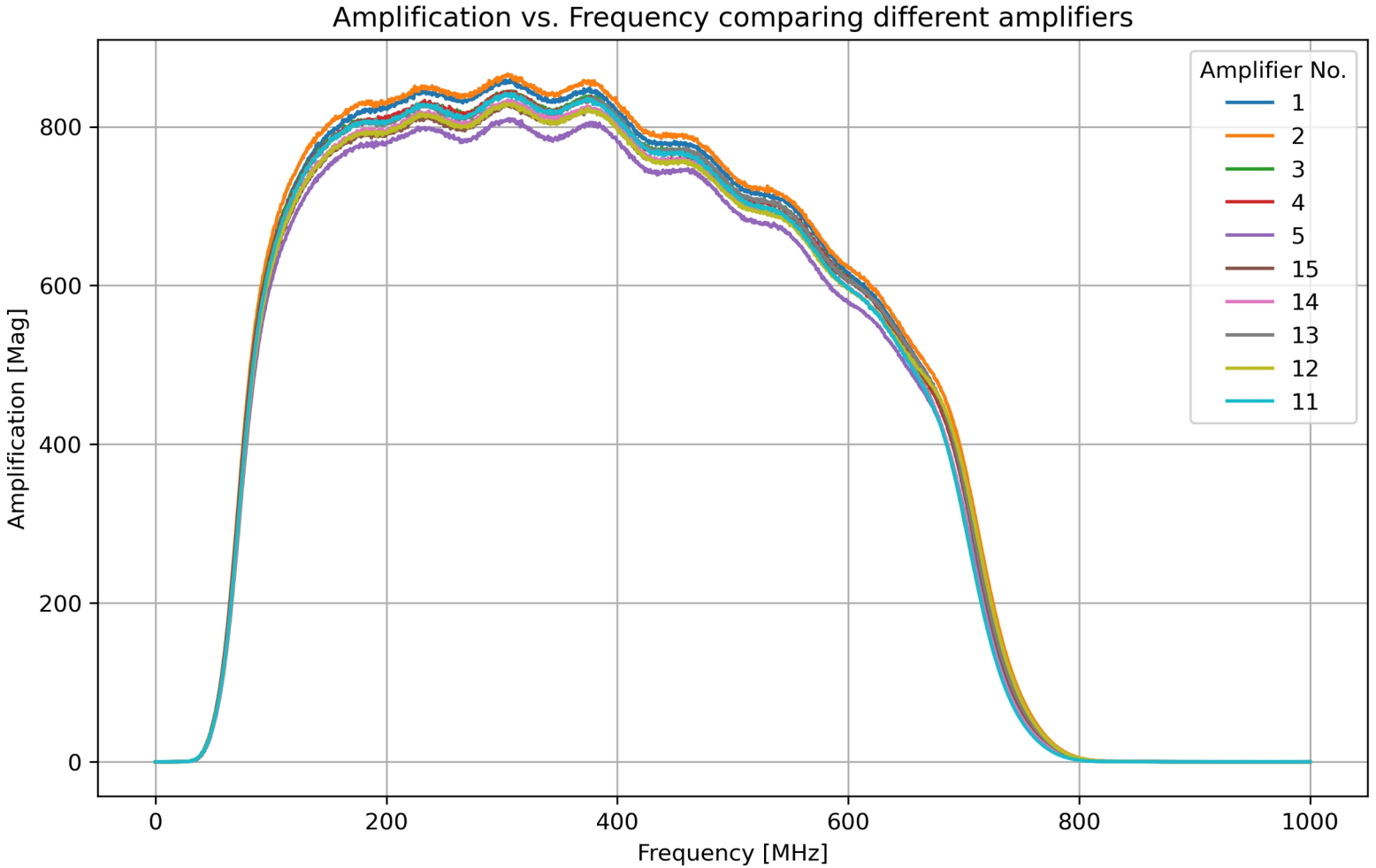
$$\begin{bmatrix} b_1 \\ b_2 \end{bmatrix} = \begin{bmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{bmatrix} \begin{bmatrix} a_1 \\ a_2 \end{bmatrix}$$

Incident waves

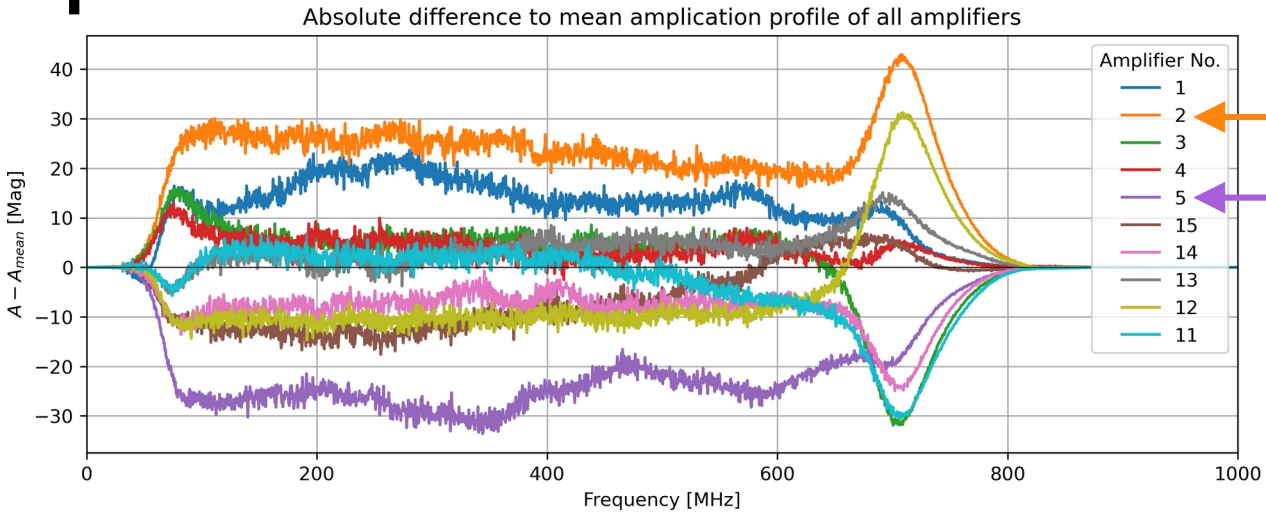
**Transmission**
**forward (*21*) / backward (*12*)**

**Reflection**
**at Port 1 (*11*) / Port 2 (*22*)**

# S21 amplitude

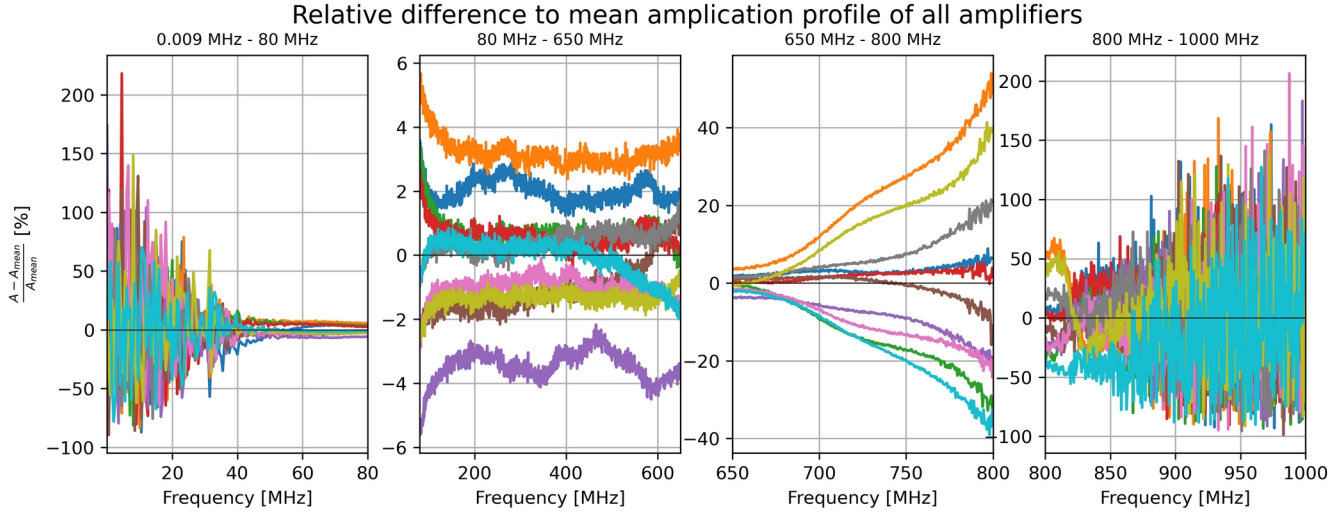


# S21 amplitude




Highest gain

Lowest gain



# S21 amplitude