

Attenuator Module V1 for the PAM

- Frequency: 0.1-20GHz
- Attenuation: 5-BIT, max: 31 dB
- Impedance: 50Ω

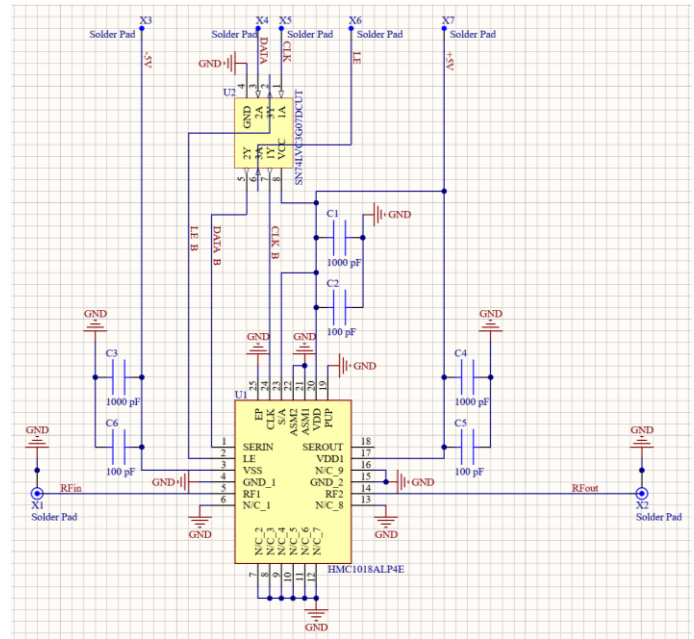
Schematic

Inputs:

- RFin: Radio signal input
- +5V: positive supply voltage (+5V@4.5mA)
- -5V: negative supply voltage (-5V@5.5mA)
- CLK: Clock Signal
- DATA: serial bit-pattern for attenuator
- LE: Latch Enable
- GND

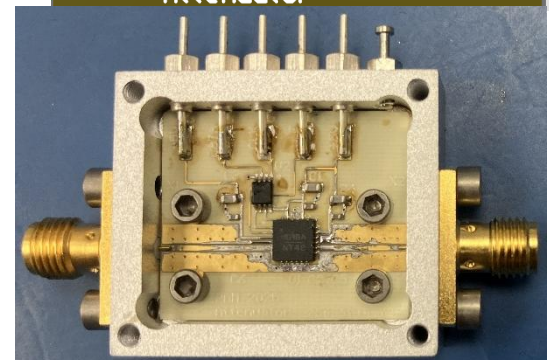
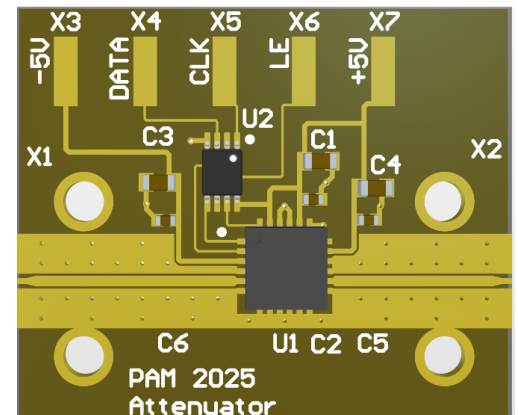
Outputs:

- RFout: Radio signal output



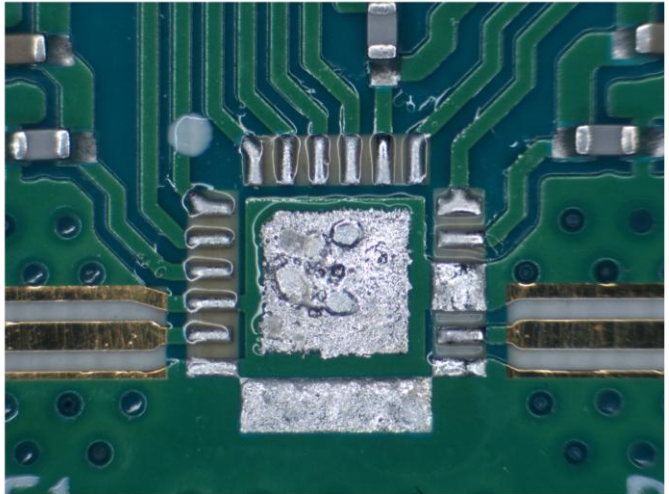
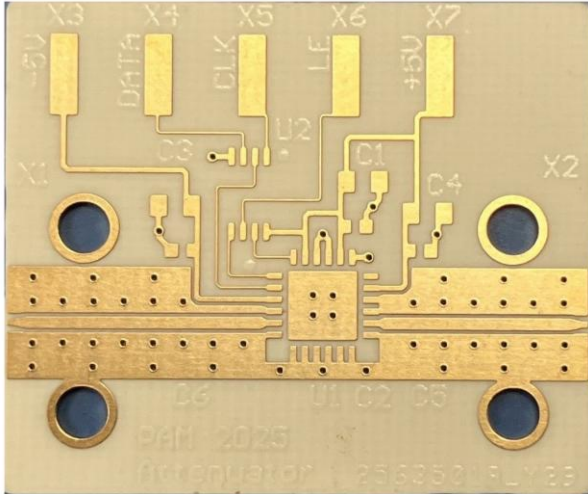
Components - All Case Codes are metric

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|--|------------|
| 2 – SMA 2Hole (142-1701-201) | [X1, X2] |
| 5 – Feed through cap 4-40UNC-2A (B3C153B) | [X3-7] |
| 1 – Turret Terminal 2-56 UNC – 2A (1595-2) | |
| 1 – variable attenuator (HMC1018ALP4E) | [U1] |
| 3 – 100pF 1005 (GRM1555C2A101FA01D) | [C2,C5,C6] |
| 3 – 1000pF 1608 (GCM1885C1H102FA16D) | [C1,C3,C4] |
| 1 – Non-Inv. buffer VSSOP-8 (SN74LVC3G17DCUR) | [U2] |
| 1 – RO4350 PCB | |
| 1 – Box | |
| 1 – Lid | |
| 4 – Screws 3-48 UNC - 2B x 3/16 (92196A091) | |
| 4 – Screws 2-56 UNC - 2B x 1/8 (21202) | |
| 4 – Screws 2-56 UNC - 2B x 5/32 (91771A884) | |
| 1 – RF-absorber PSA 0.08”, ca. 20 x 24 mm (MR42-0008-20) | |



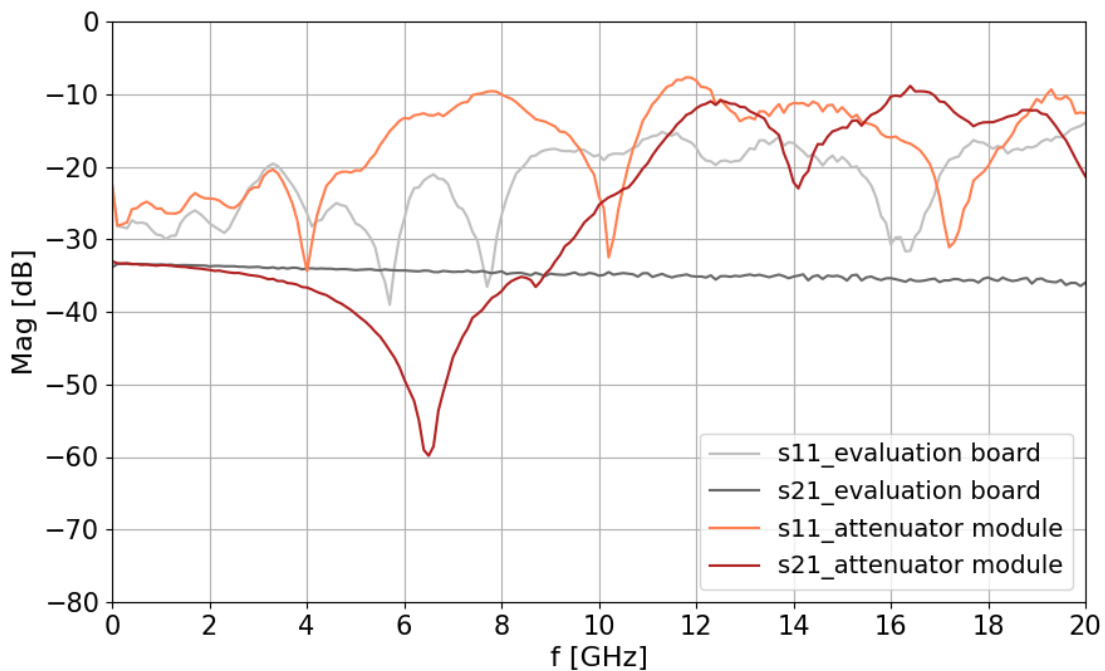
Footprint

Footprint of attenuator module (left) compared to footprint of commercially available evaluation board with the same attenuator (right).



S-parameters

S-parameter measurement with the VNA (N5230C) of attenuator module v1 (red) in comparison to attenuator evaluation board (gray).



Troubleshooting

- Attenuator replacement had no effect, ruling out a **faulty component**.
- Evaluation board performed well, confirming the **attenuator model** is not the issue.
- Switching off the **power supply** had no impact on the irregularity of the modules S21 trace. The S21 trace of the evaluation board looked smooth even with the power switched off.
- Amplifier and detector modules performed correctly, despite using the same **CPW and SMA transitions**.
- HFSS simulations indicated that **trace-to-attenuator transitions** should not significantly degrade performance.
- Two key differences found between the **footprints** of the attenuator module and evaluation board:
 1. **Ground plane** in the module is narrowed over a longer distance.
 2. **Ground pads** on the evaluation board are directly connected to the central ground pad, allowing RF energy to escape from the trace.