

Doppler Simulator for 10 GHz Doppler Radar

Presented by
Ngeok Kuan Wai
2252462

Supervised by
Prof. Dr.-Ing. K. Solbach

UNIVERSITÄT
DUISBURG
ESSEN



Outline

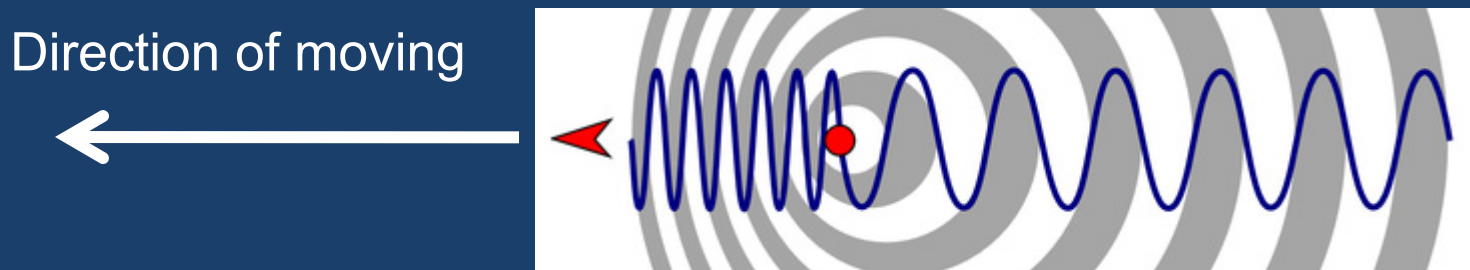
- Motivation
- Doppler Radar and Doppler Simulator
- Phase shifter
- Other Electronic Circuits/ Devices
- Optimization of the Design
- Final Result

Motivation

- To design a Doppler simulator
 - To design electronic circuits which
 - enable phase shifter to produce linear phase shift and constant insertion loss.
 - generate ramp voltage with adjustable sweeping frequencies.

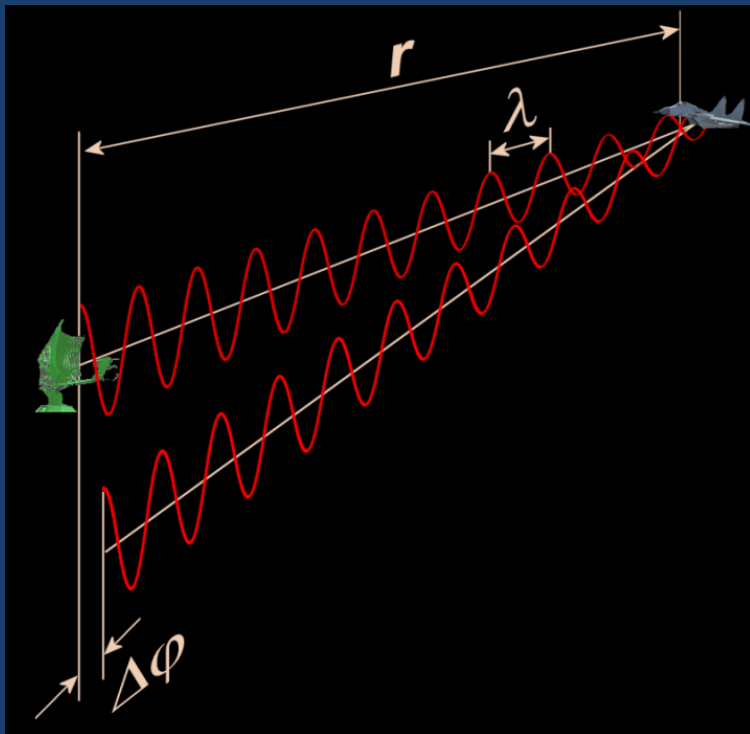
Doppler Radar and Doppler Simulator

- Doppler Effect:
 - Detection of frequency change due to relative motion between source and observer
 - When source moves towards observer, higher frequency is detected, and vice versa.



Doppler Radar and Doppler Simulator

- Doppler Radar:
 - Make use of Doppler Effect to measure the speed of detected objects.



- Doppler frequency,
 $f_d = 2 v f_r / c_o$
- *Rate of phase shift is velocity dependent*

Doppler Radar and Doppler Simulator

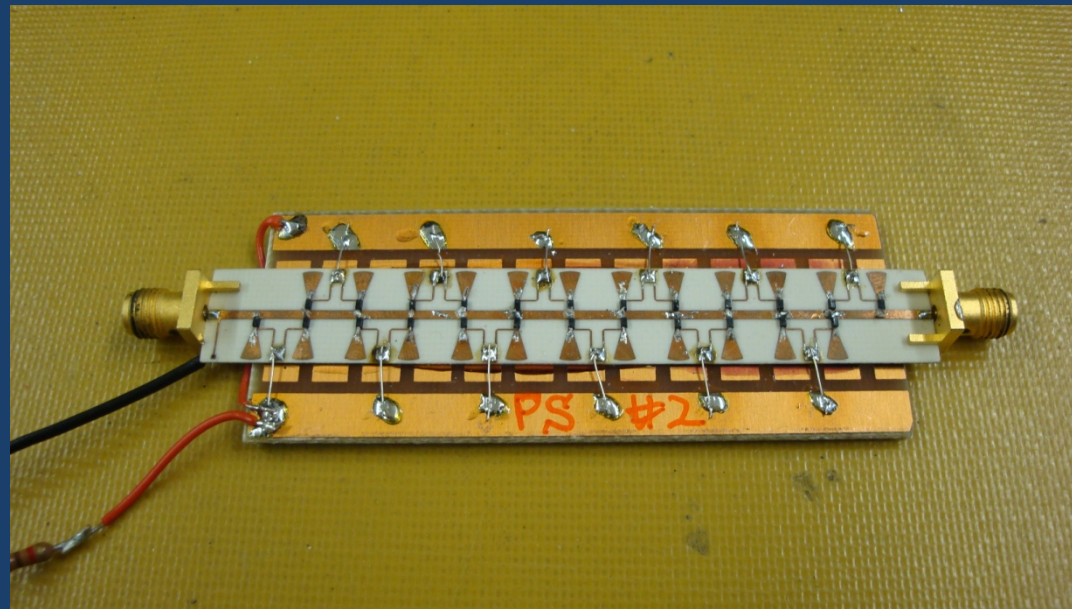
- Question:
Is Doppler radar possible to detect movement when there is only a stationary object?
- Answer:
Yes, only if the stationary object generates Doppler wave (continuous phase-shifted wave).

Doppler simulator !!

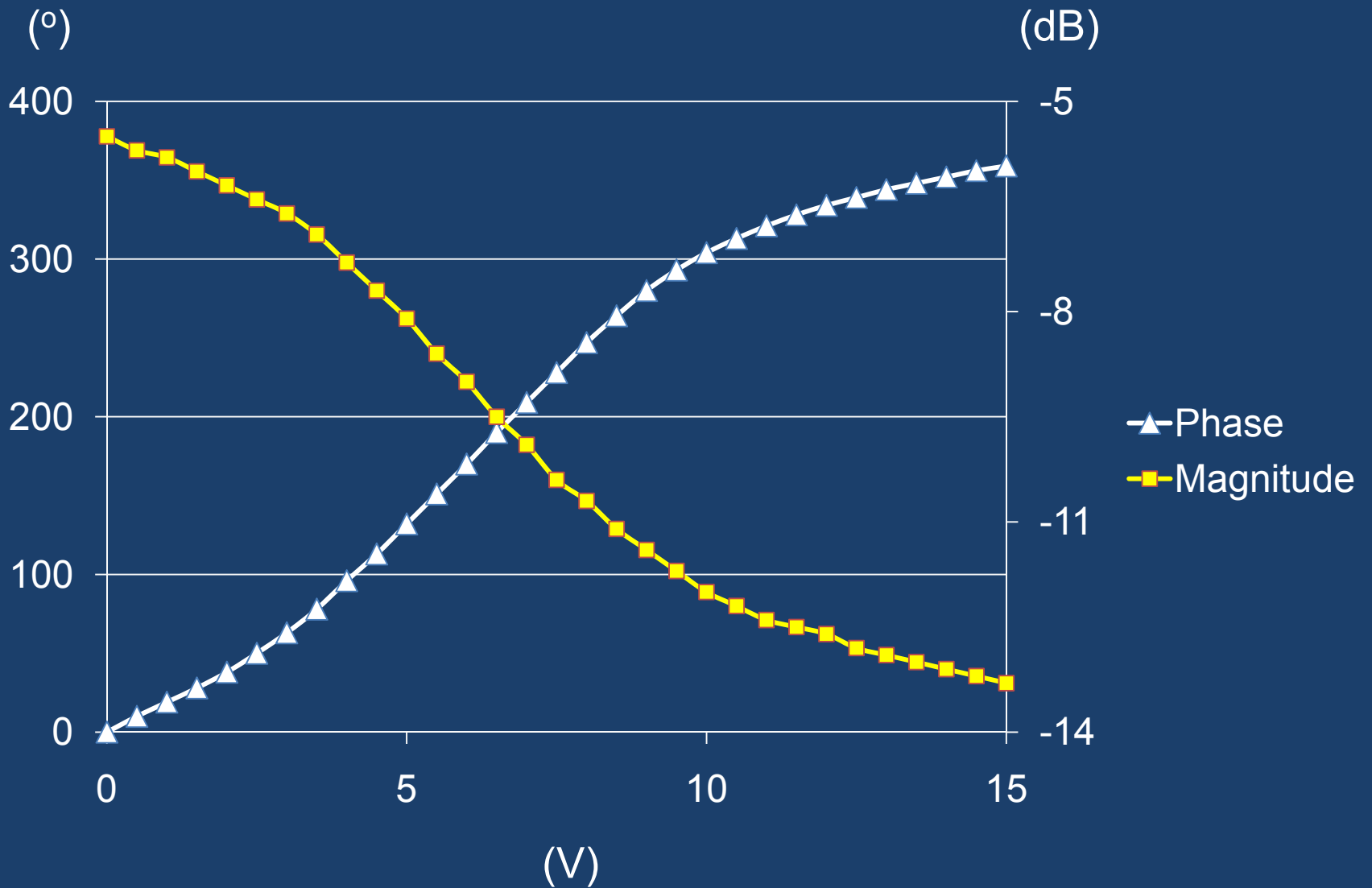
Phase Shifter

- A 2-port device which is able to provide change in the phase of RF signal.

Control voltage →



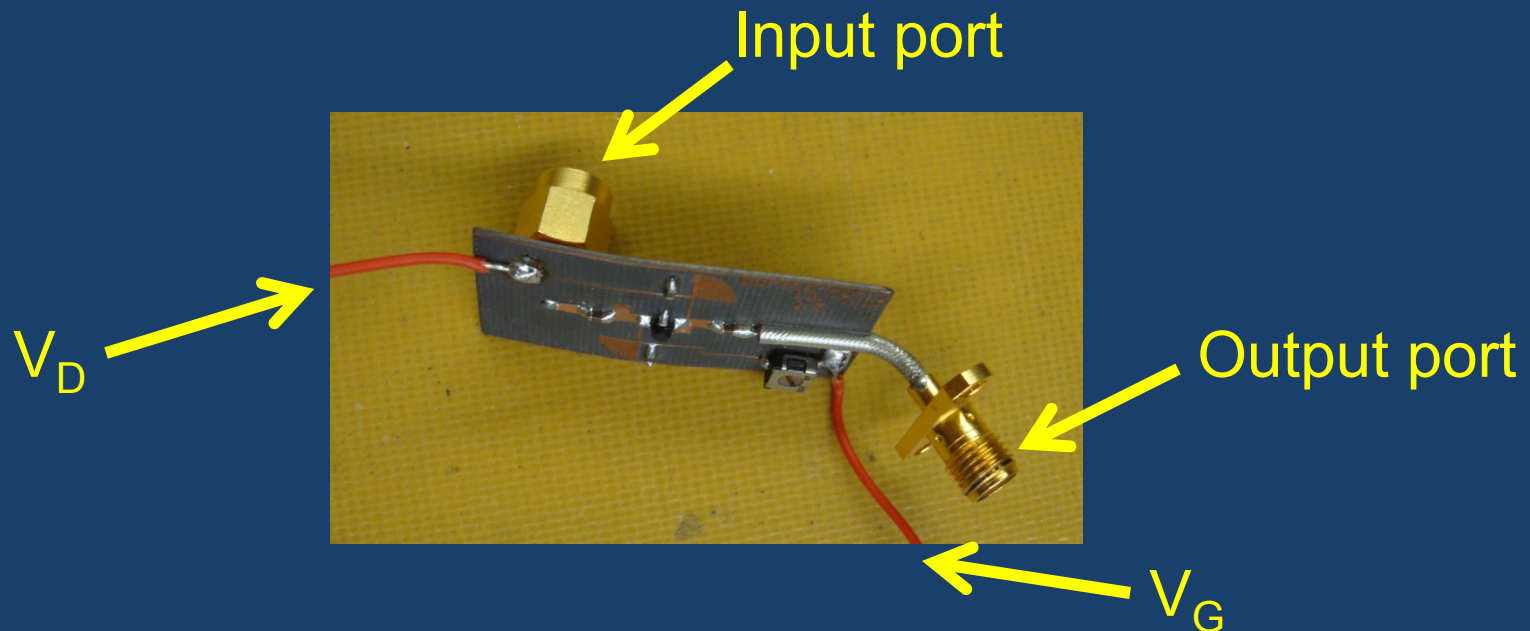
Phase Shifter



Other Electronic Circuits/ Devices

1. Voltage-controlled amplifier:

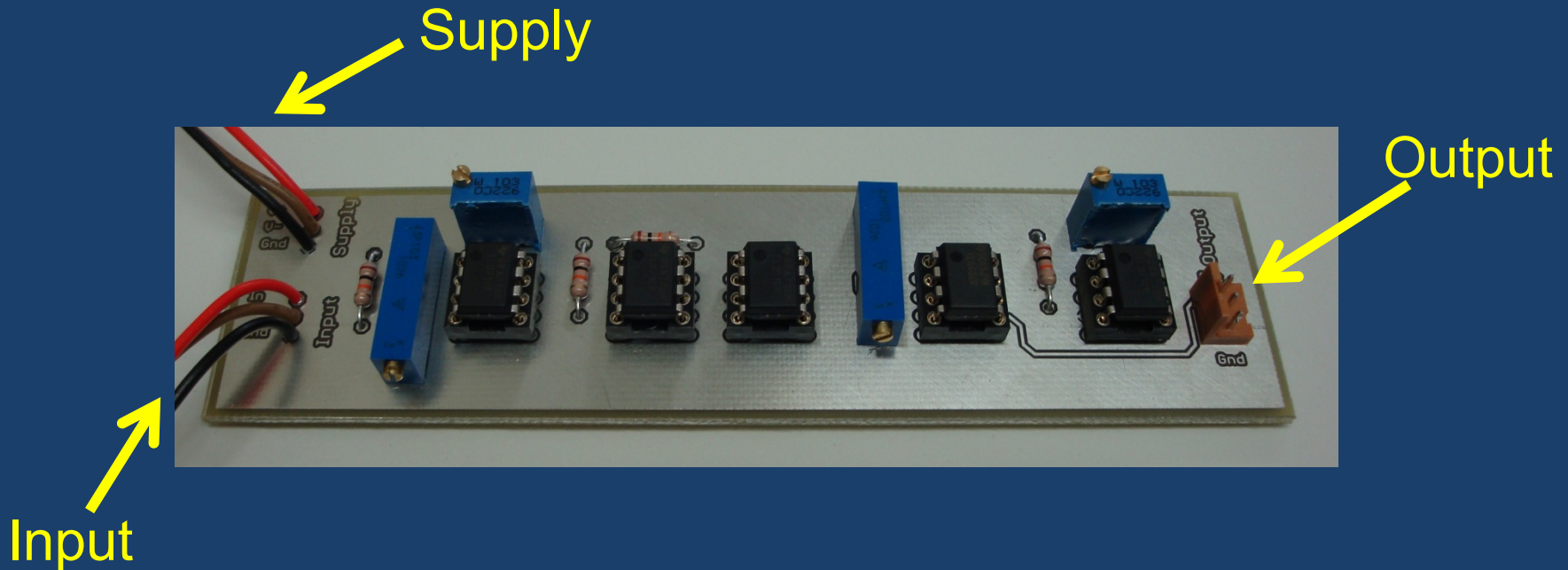
- To compensate the variation in insertion loss of the phase shifter
- Amplification depends on the control voltage



Other Electronic Circuits/ Devices

2. Level shifter:

- To shift control voltage to the required level.



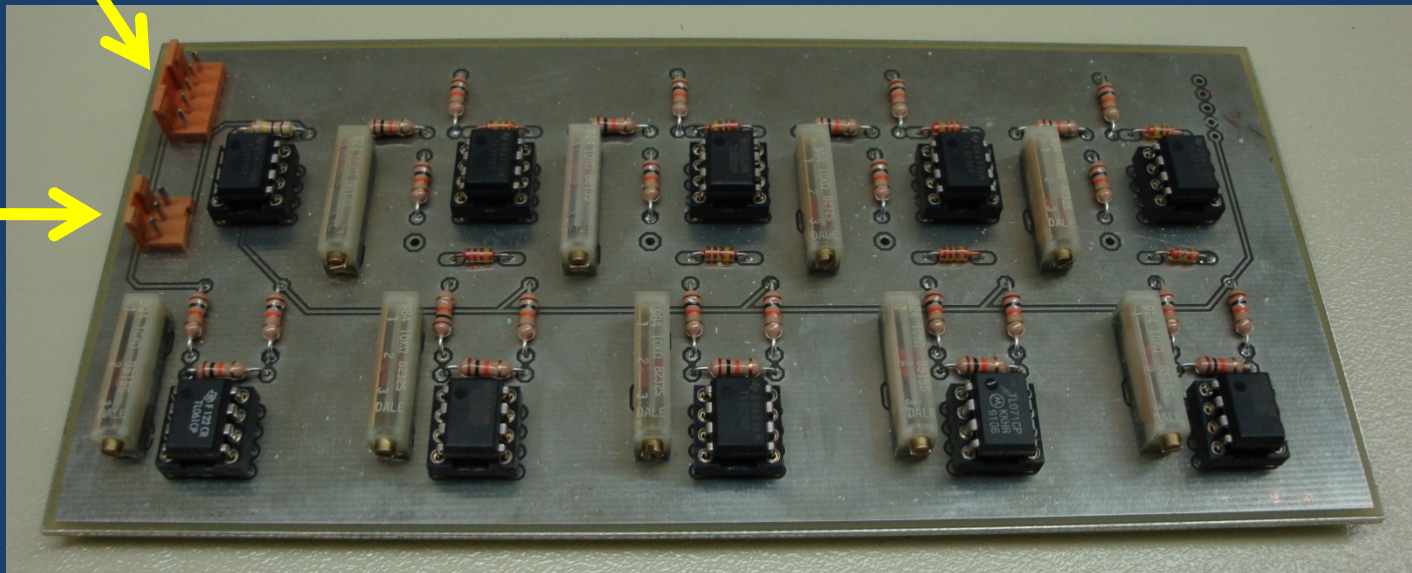
Other Electronic Circuits/ Devices

3. Equalizer:

- To transform control voltages to particular voltage function

Supply and Input

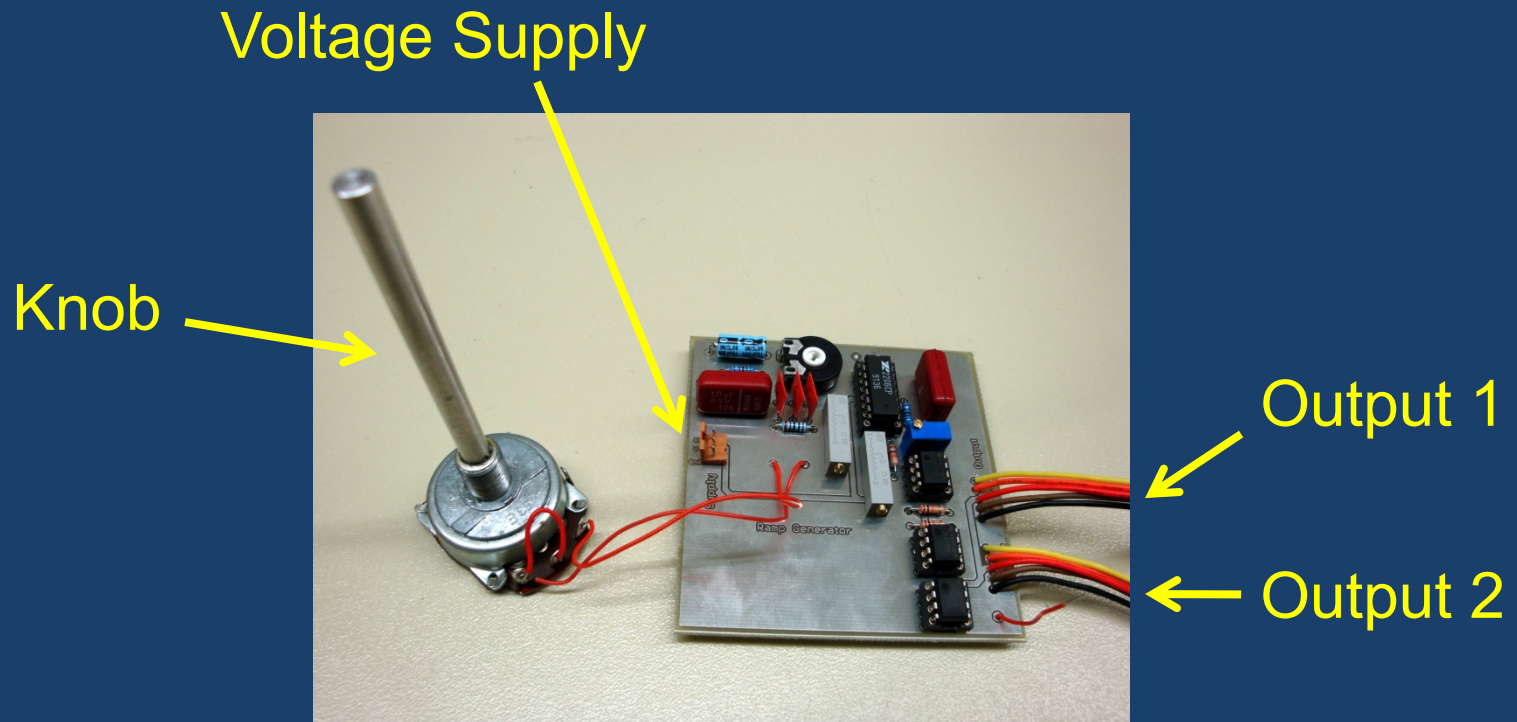
Output



Other Electronic Circuits/ Devices

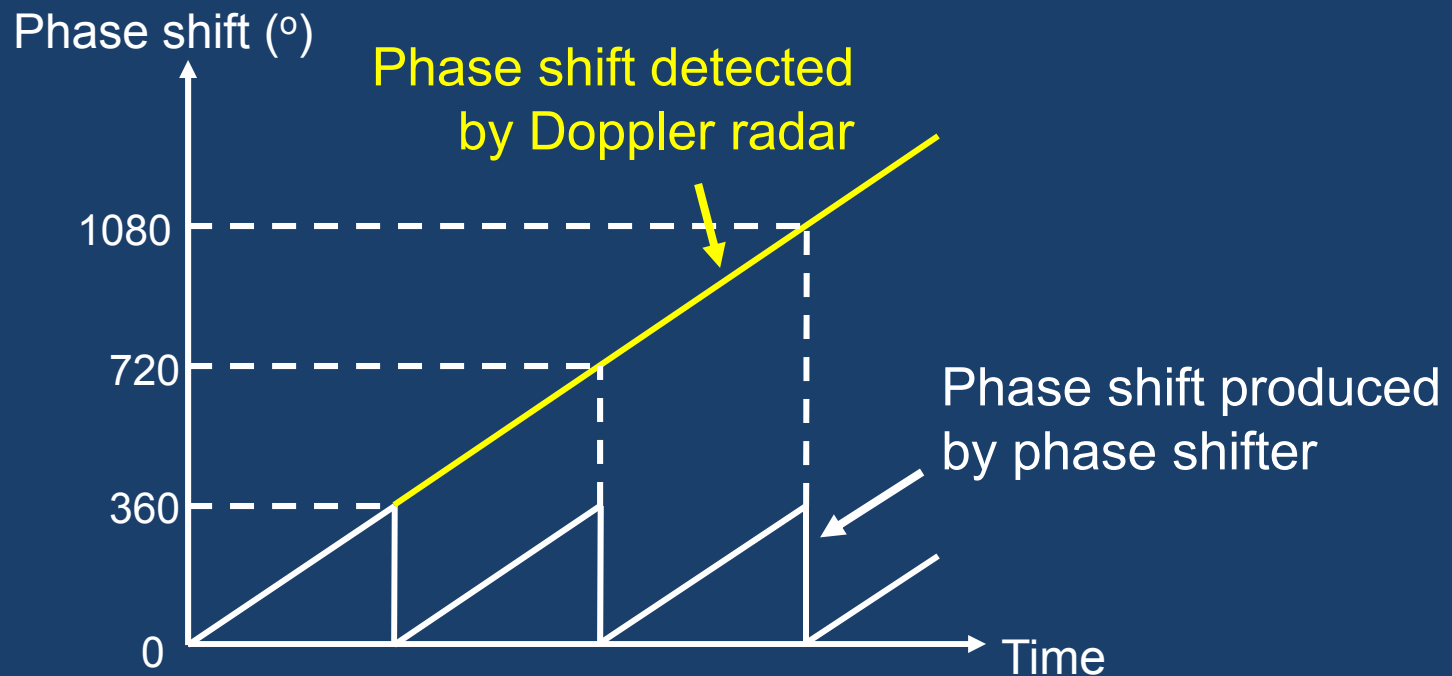
4. Ramp generator

- To generate ramp voltage waveform with adjustable sweeping frequencies

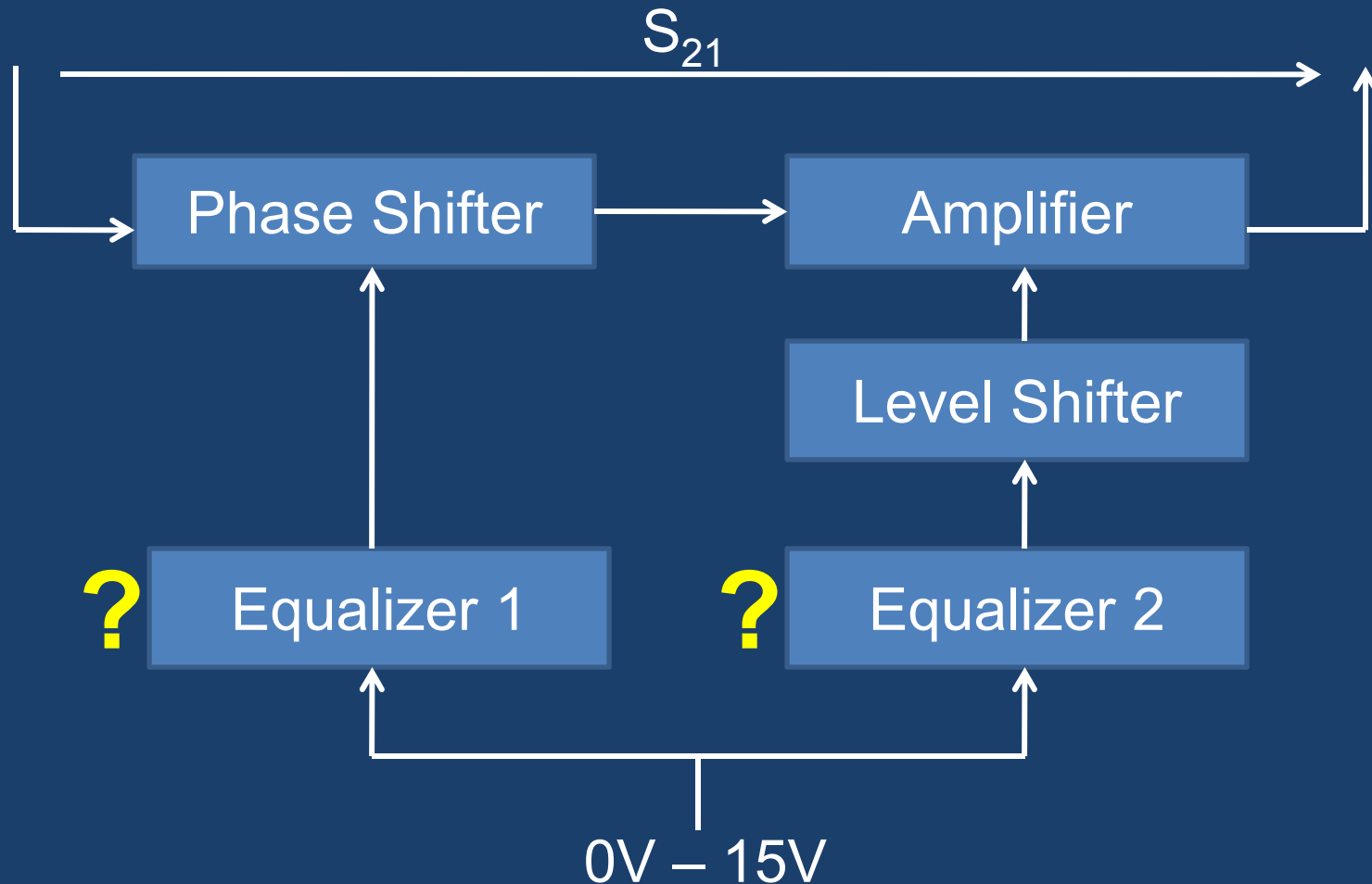


Other Electronic Circuits/ Devices

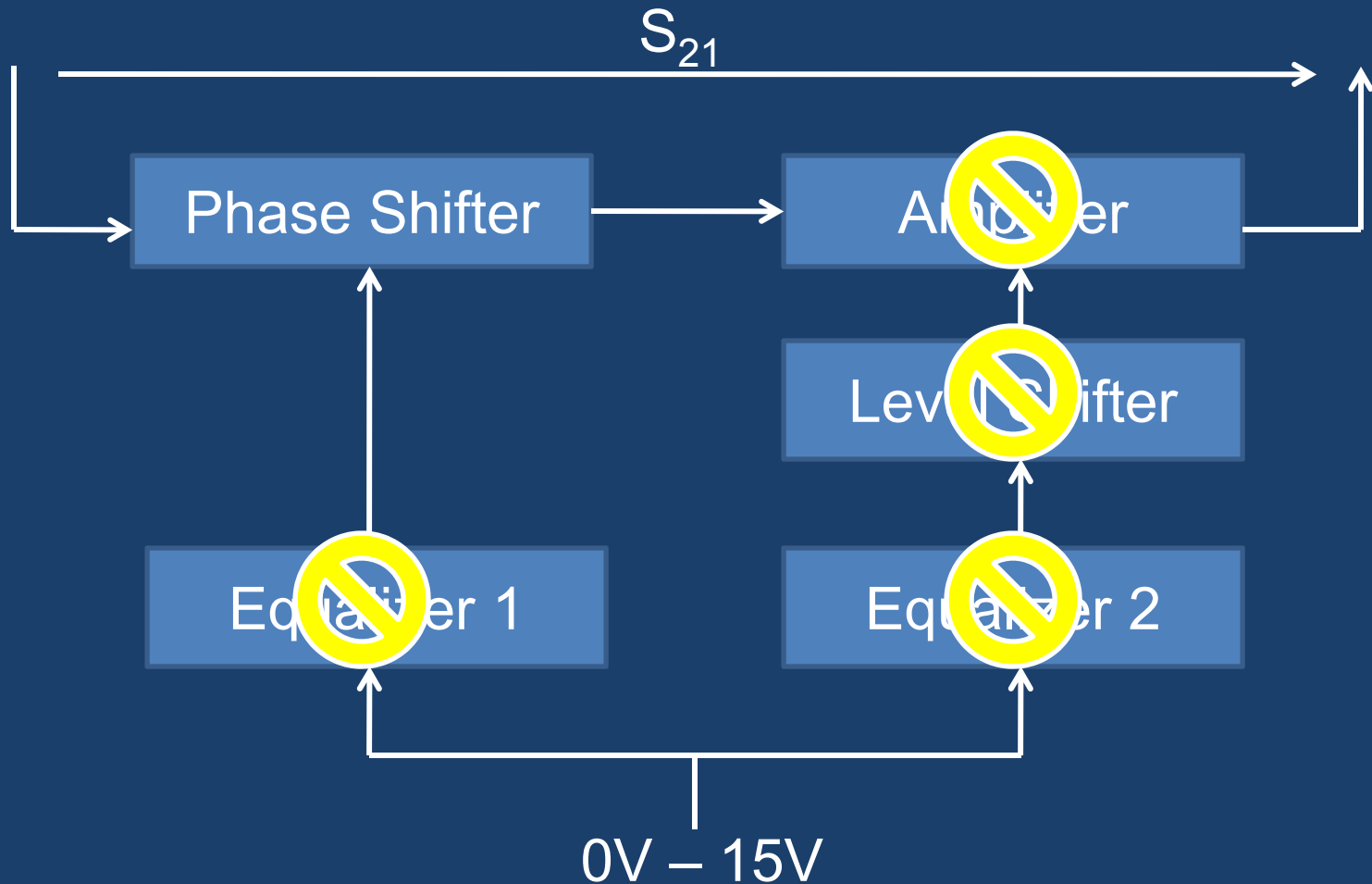
4. Ramp generator



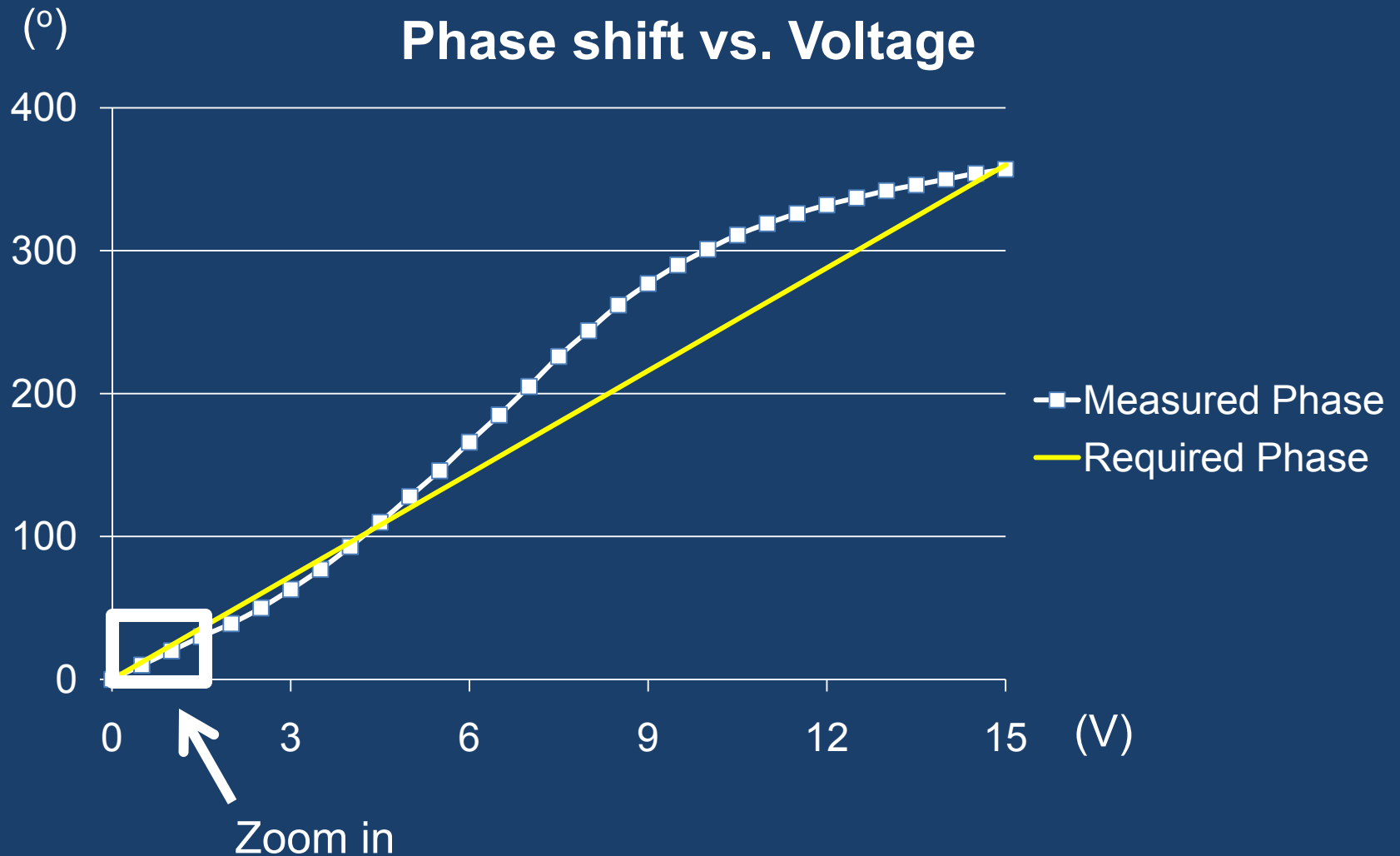
Optimization of the Design



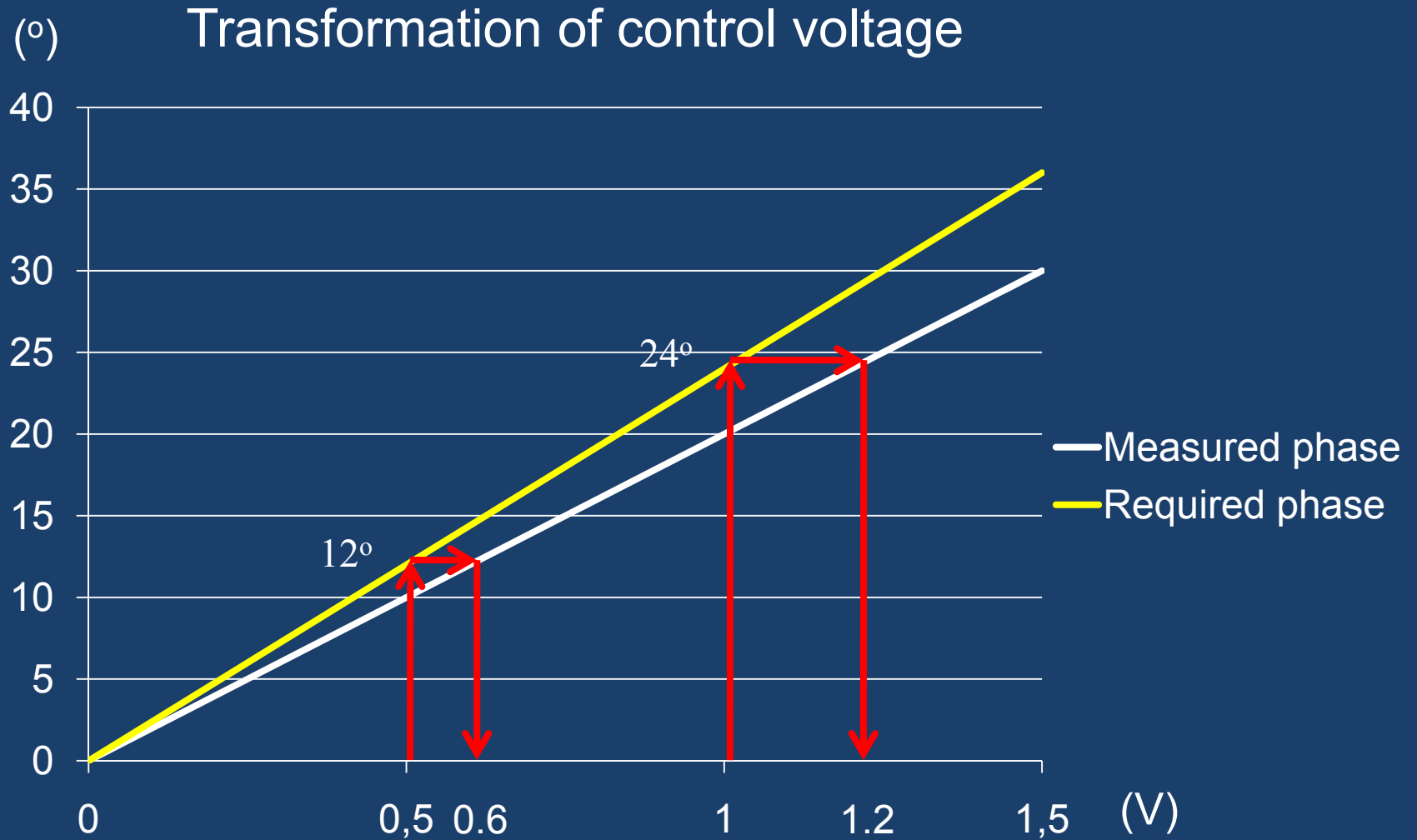
Optimization of the Design



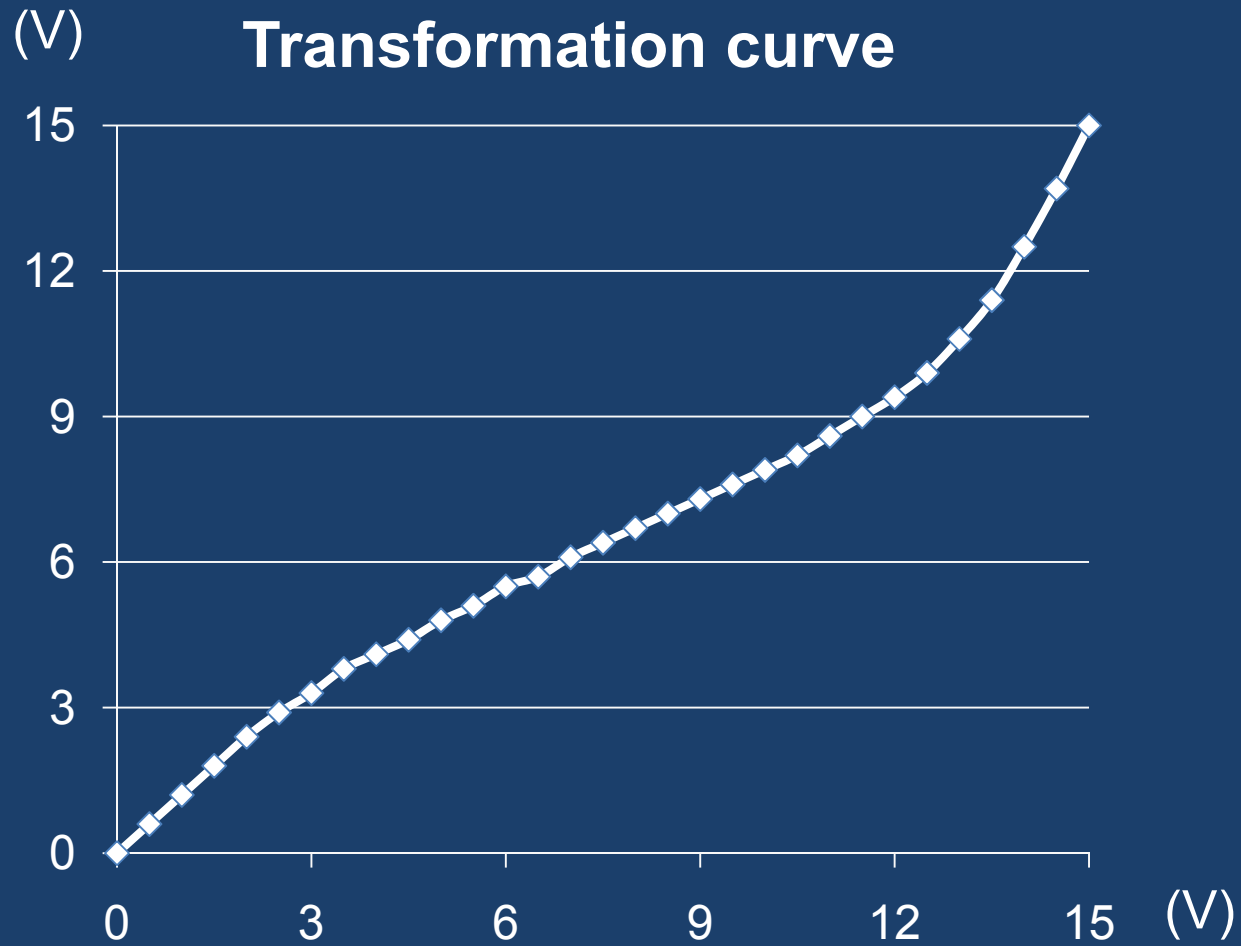
Optimization of the Design



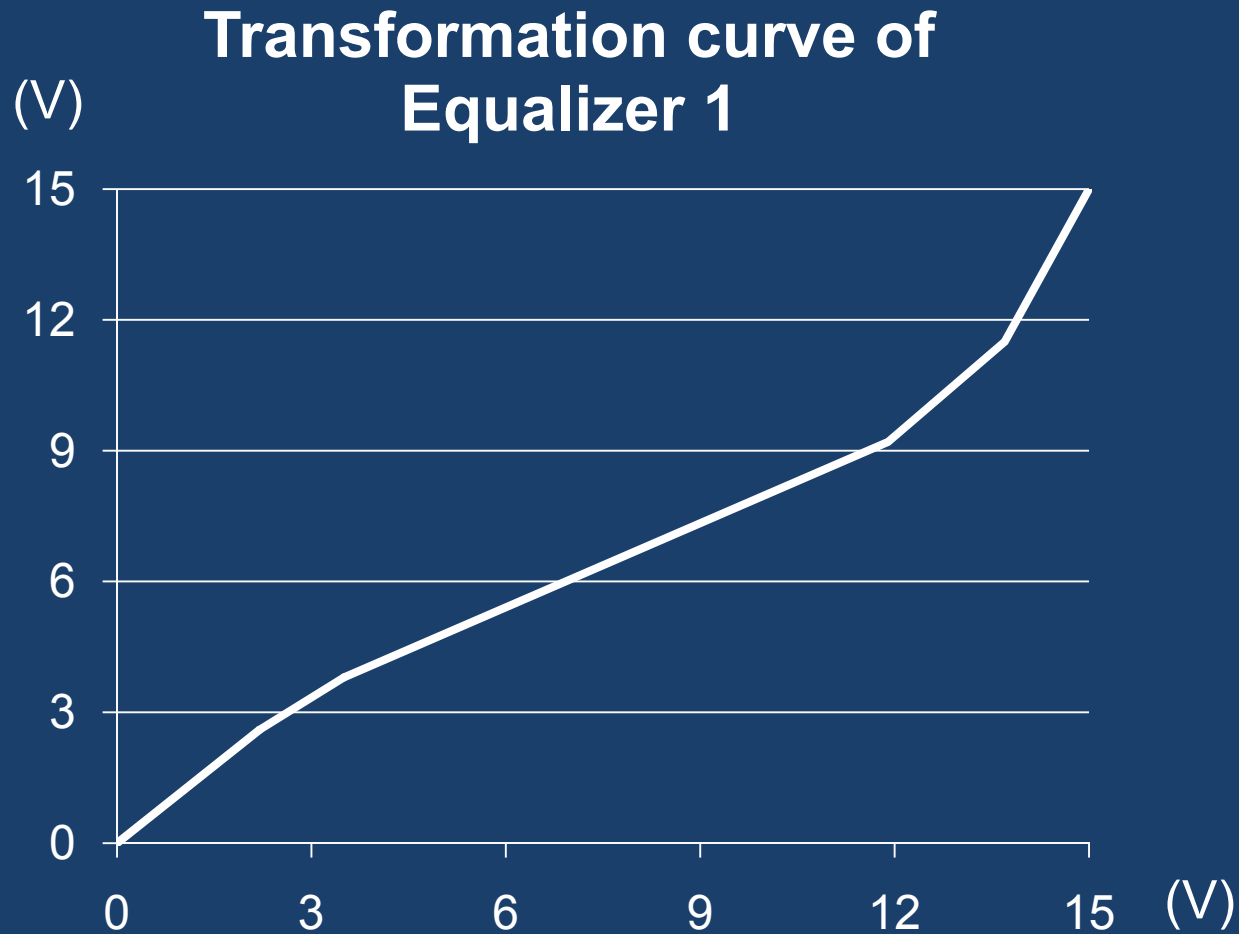
Optimization of the Design



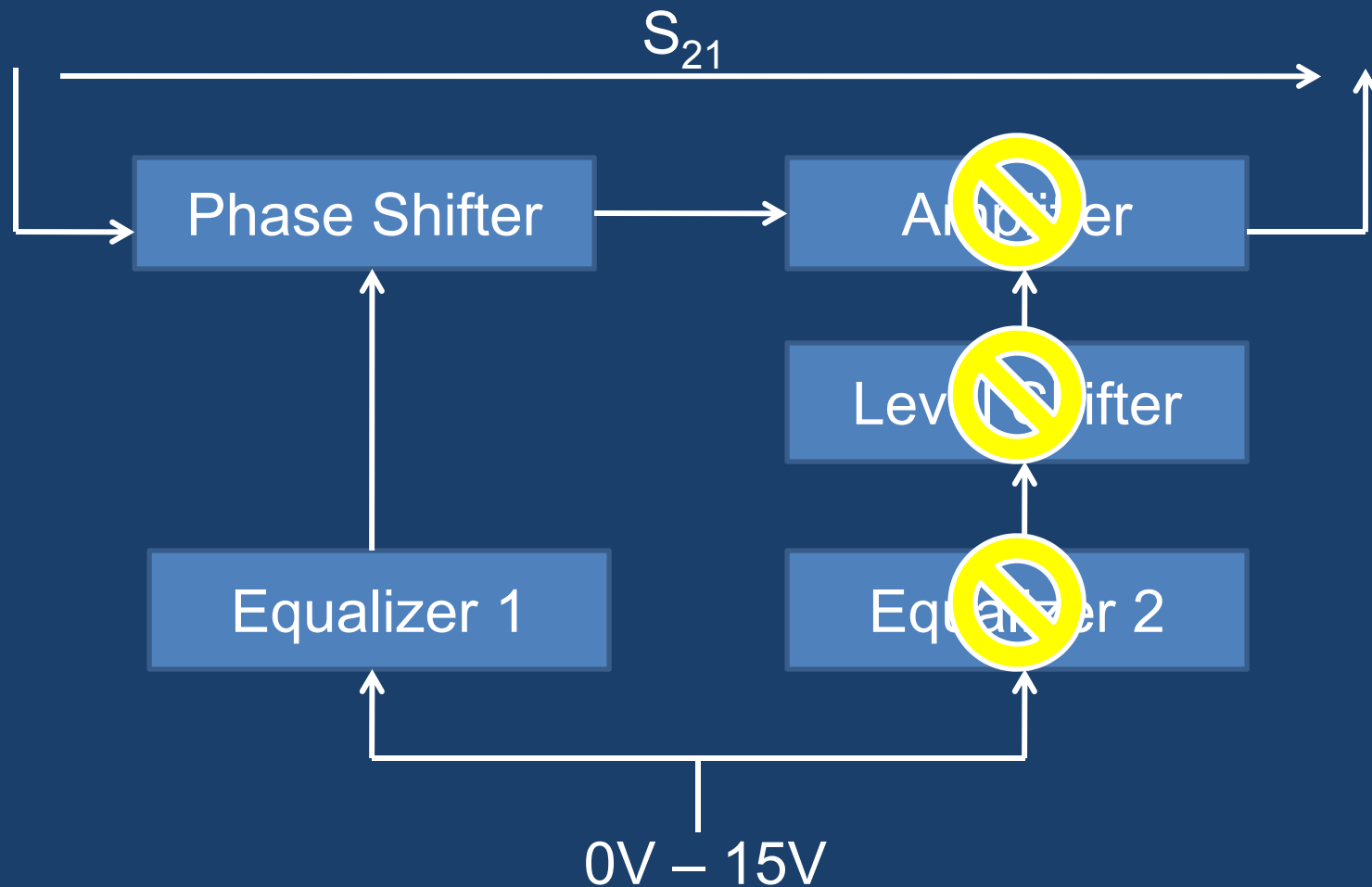
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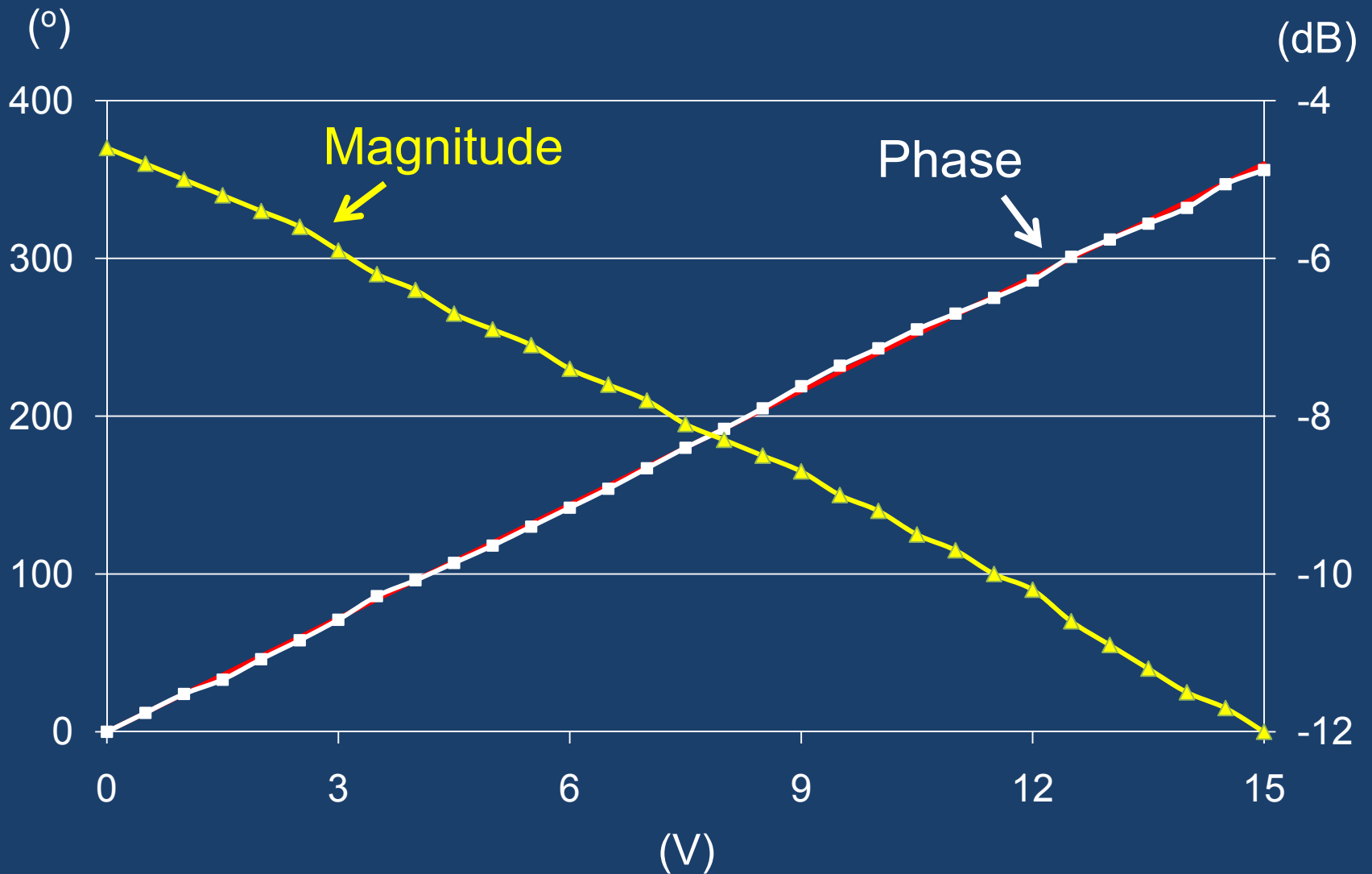
Optimization of the Design



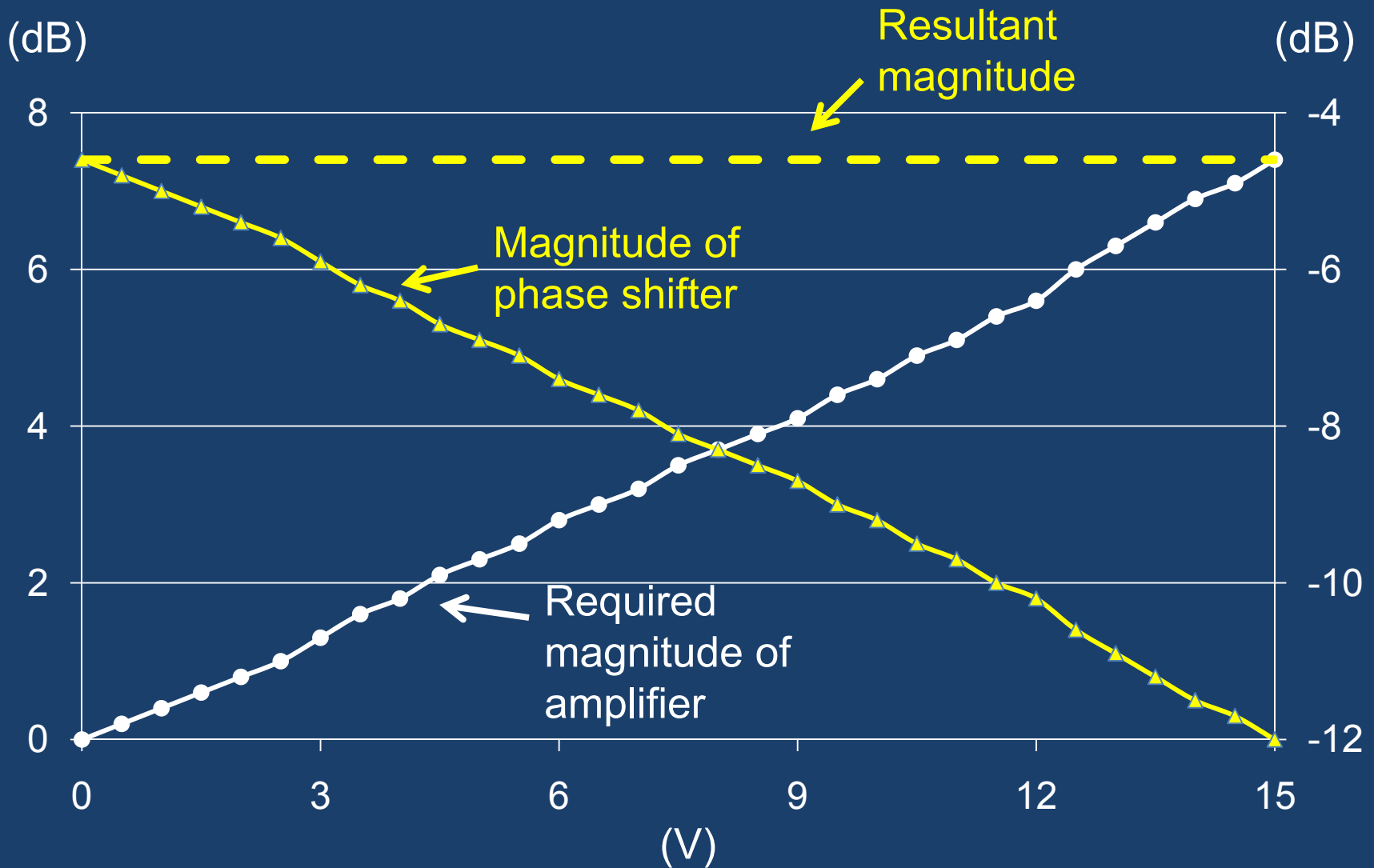
Optimization of the Design



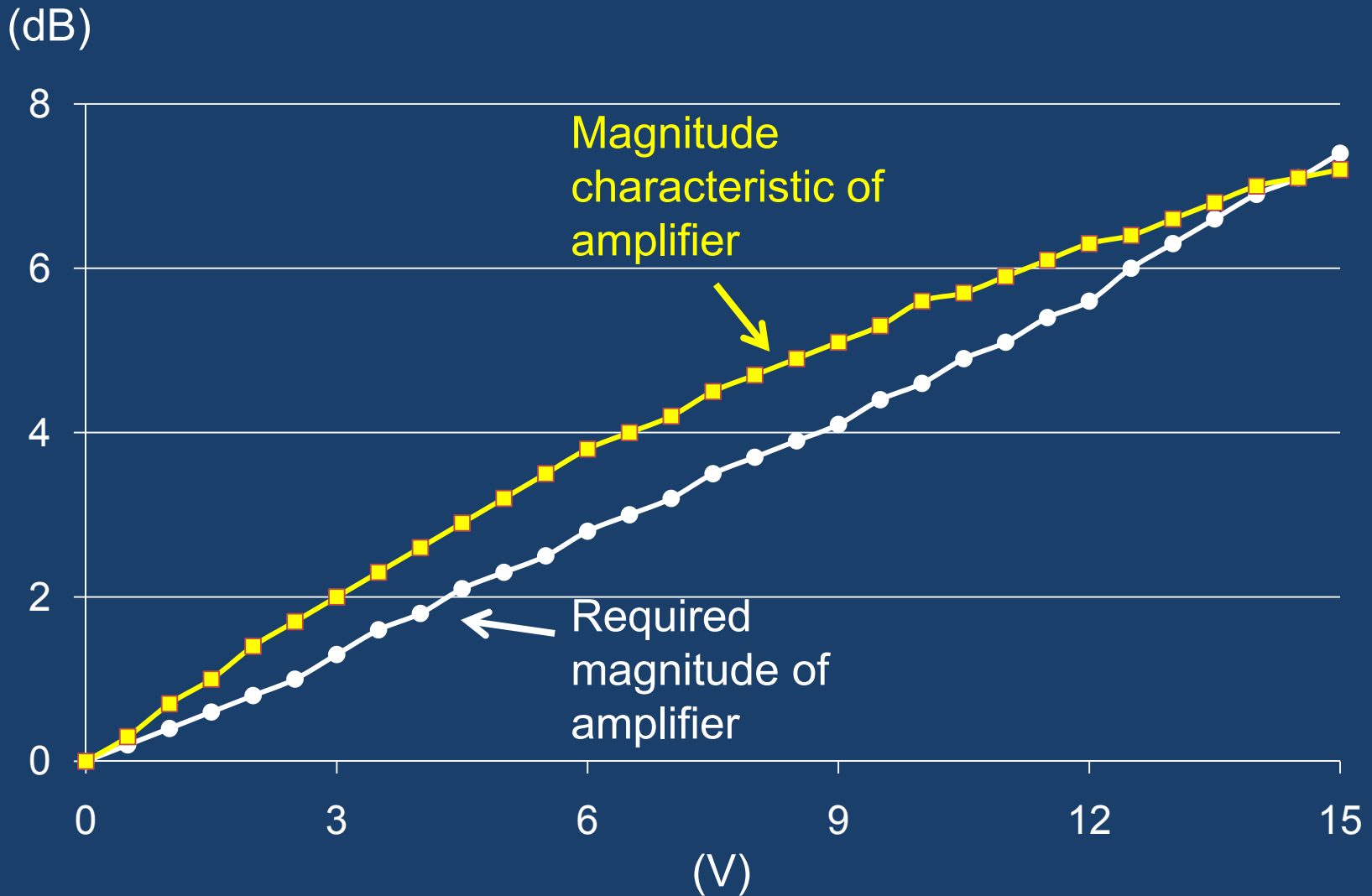
Optimization of the Design



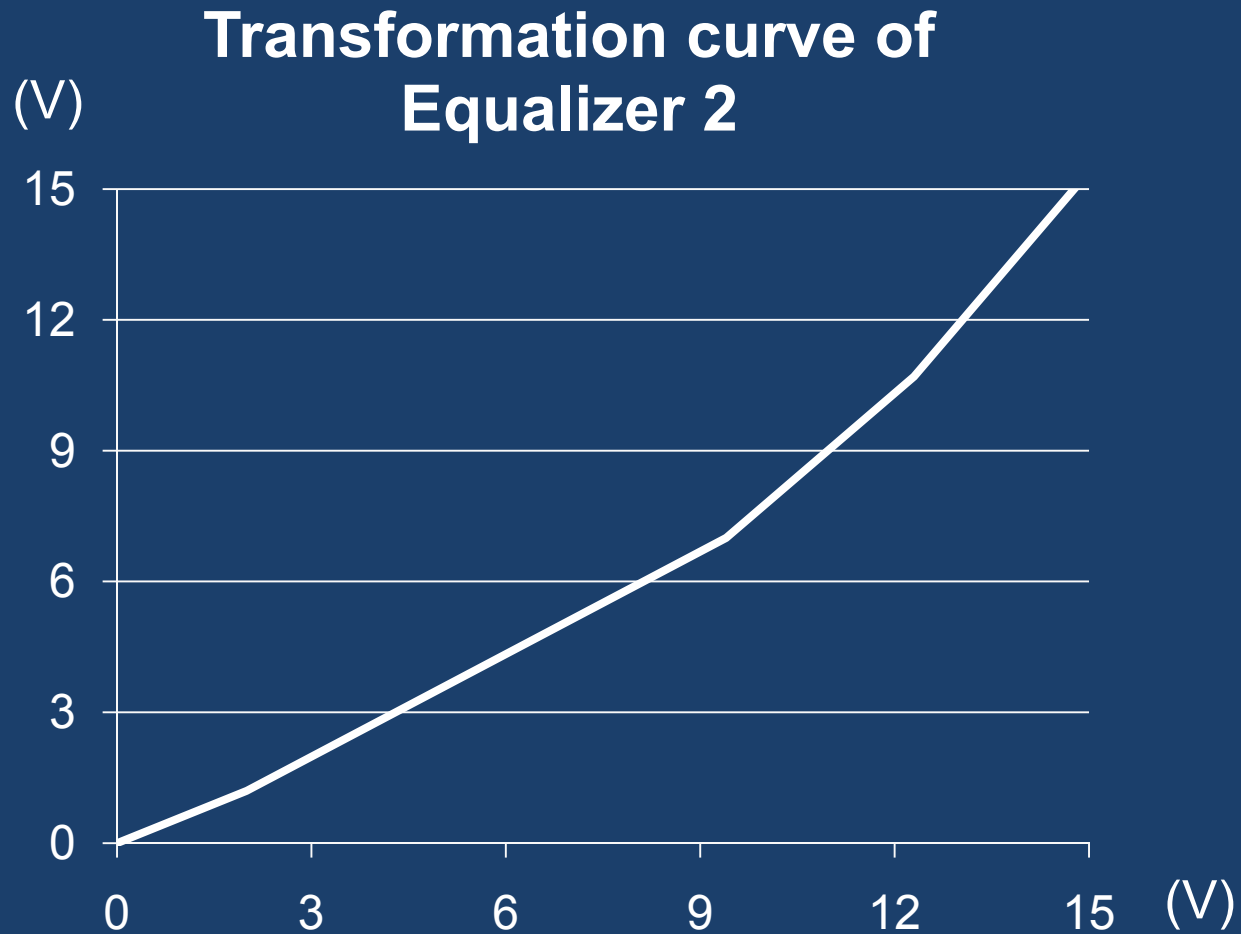
Optimization of the Design



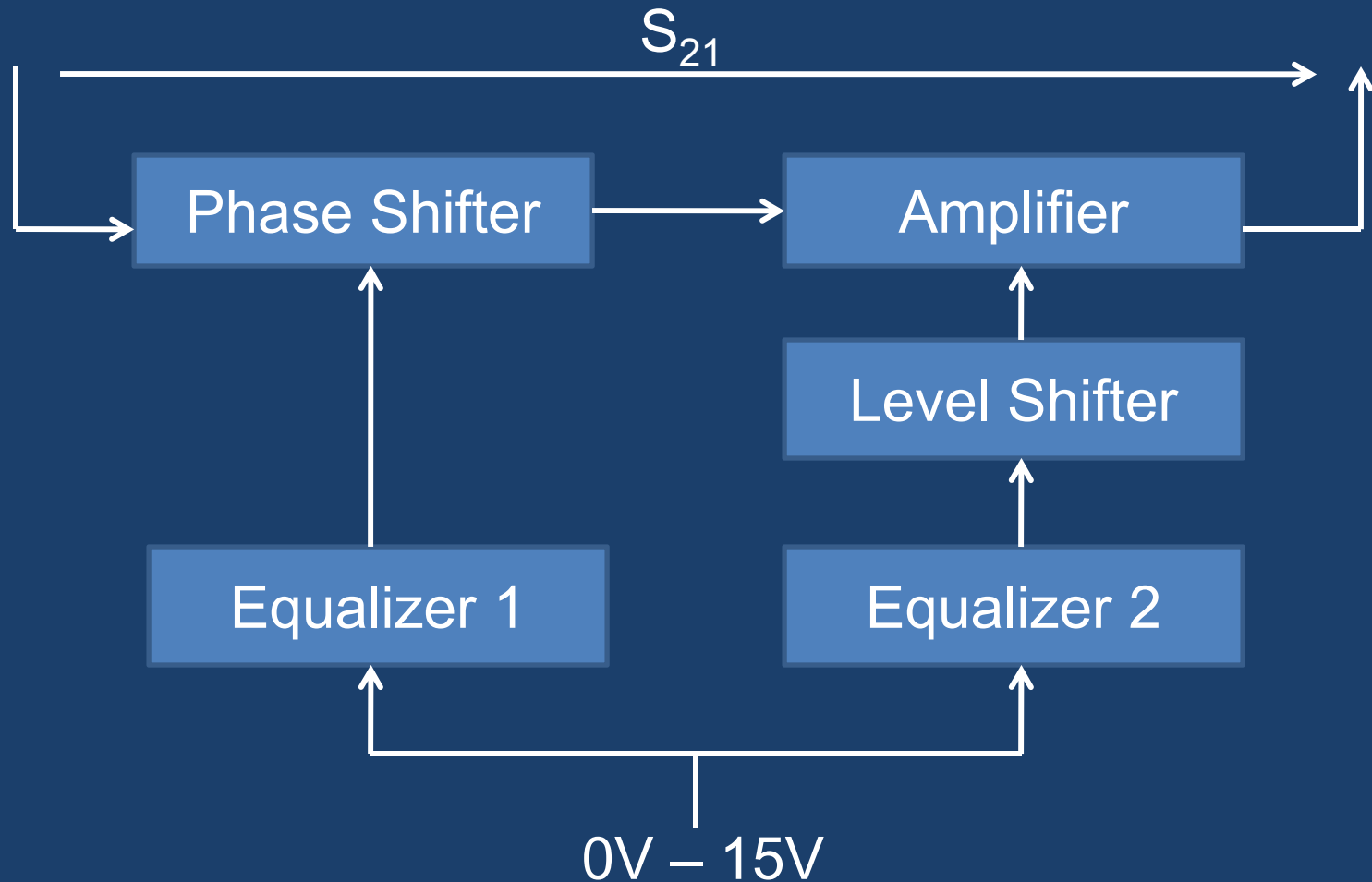
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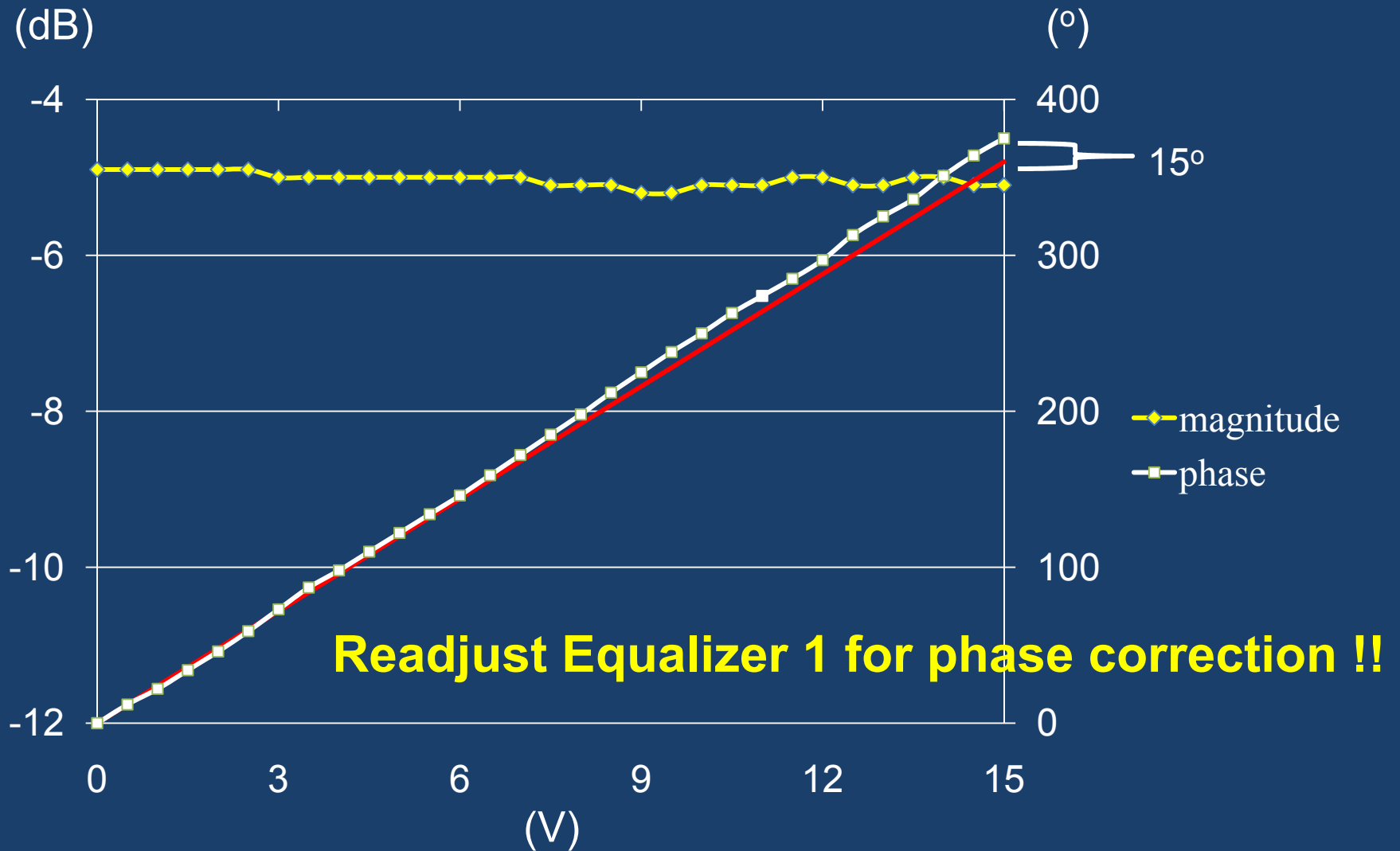
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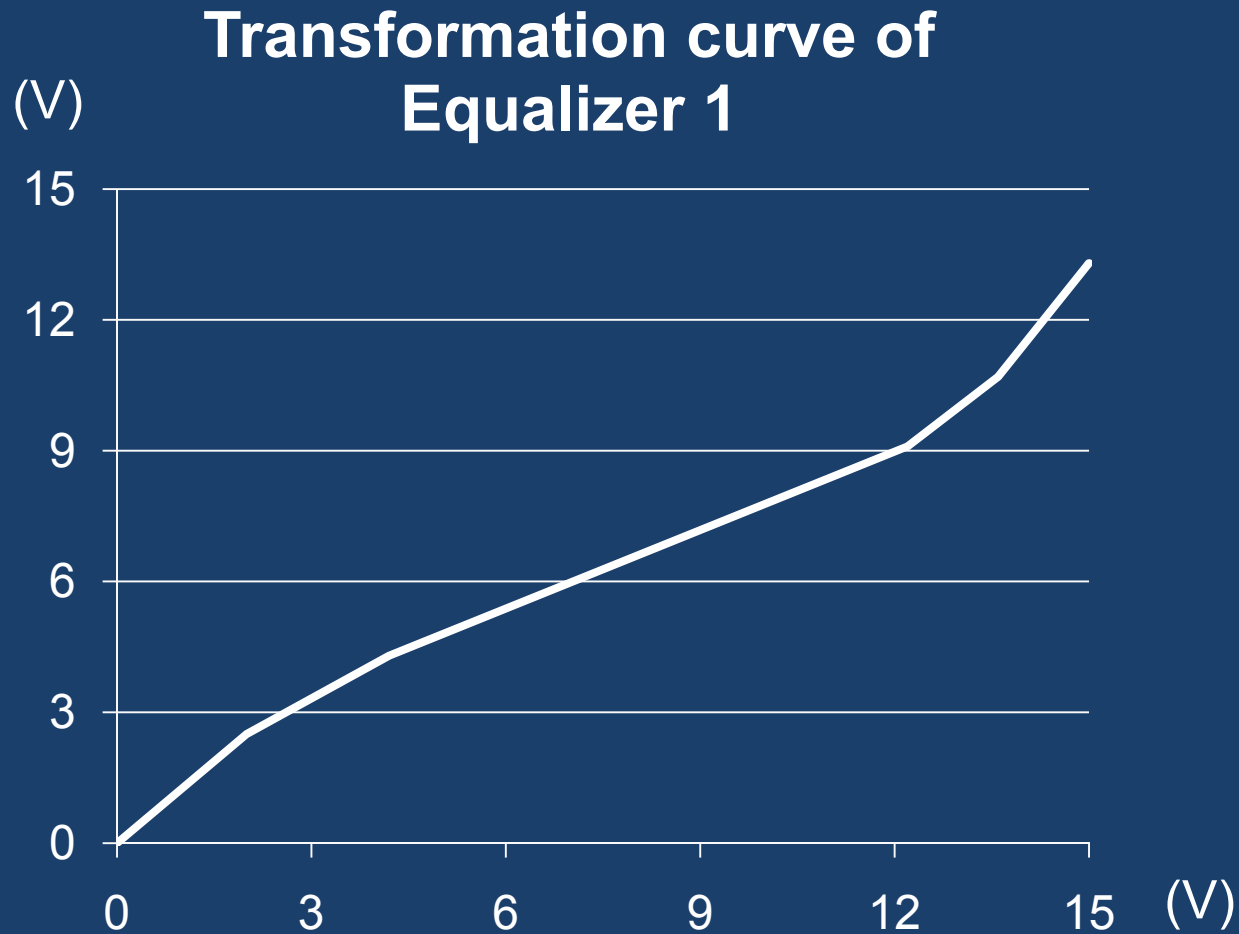
Optimization of the Design



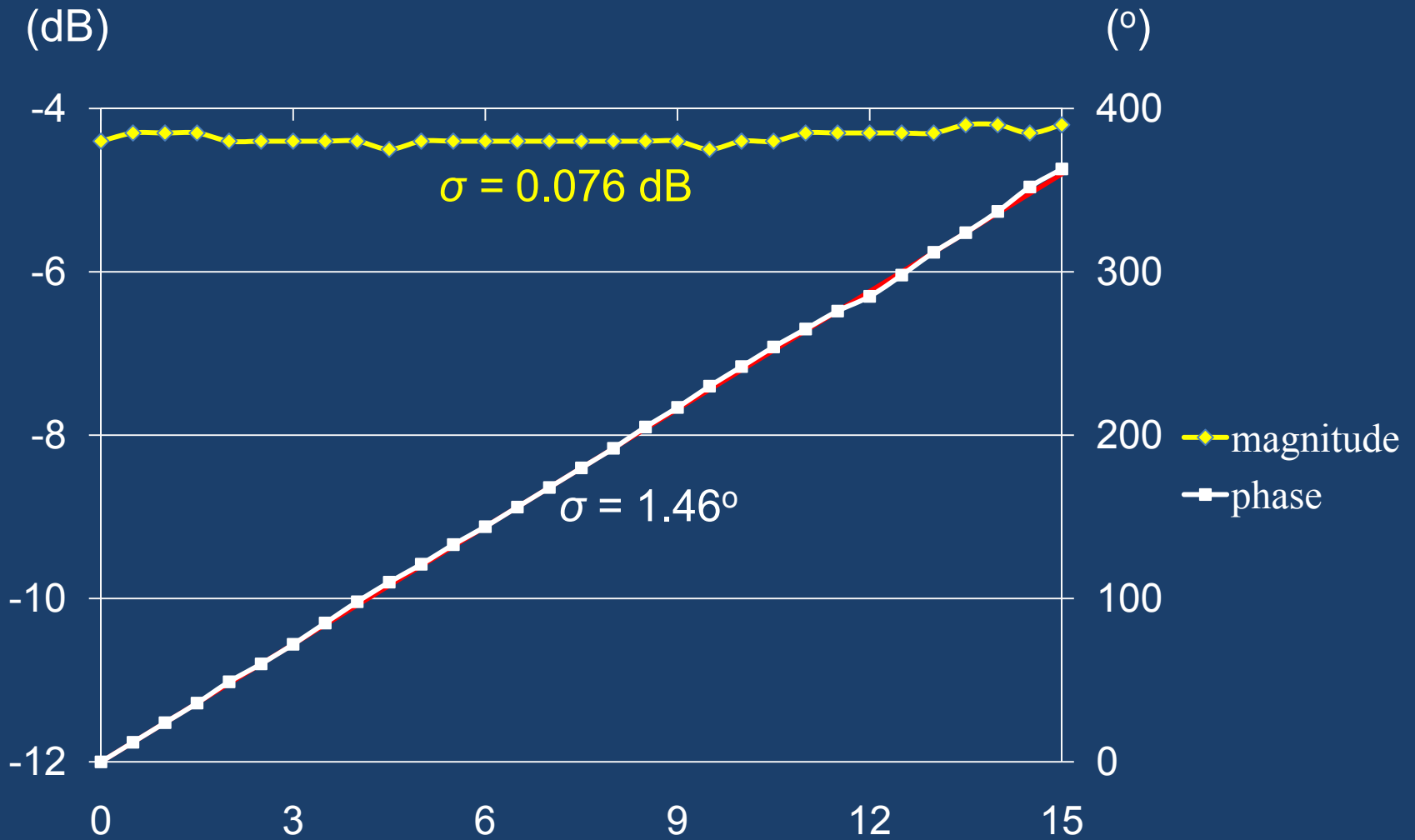
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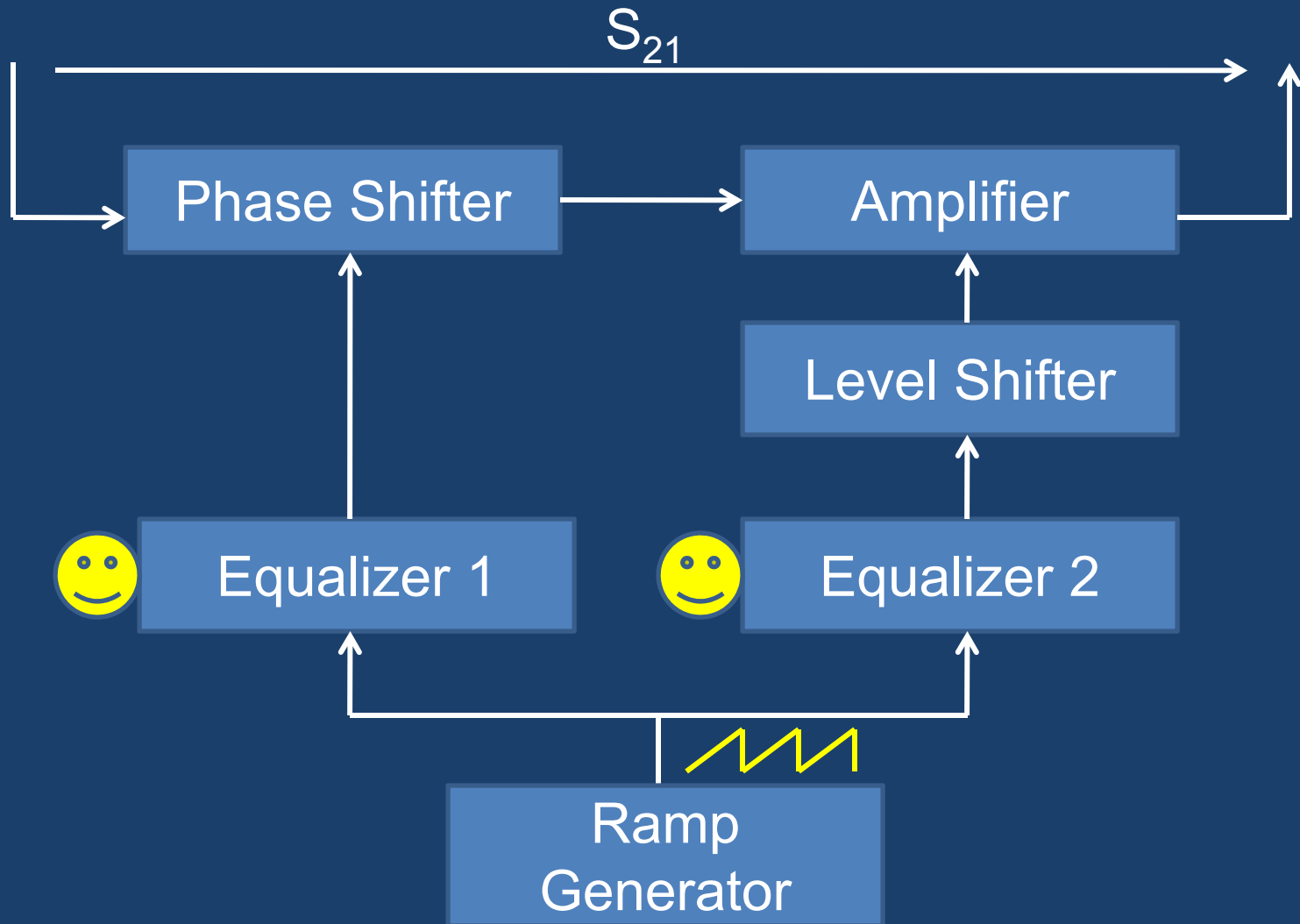
Optimization of the Design



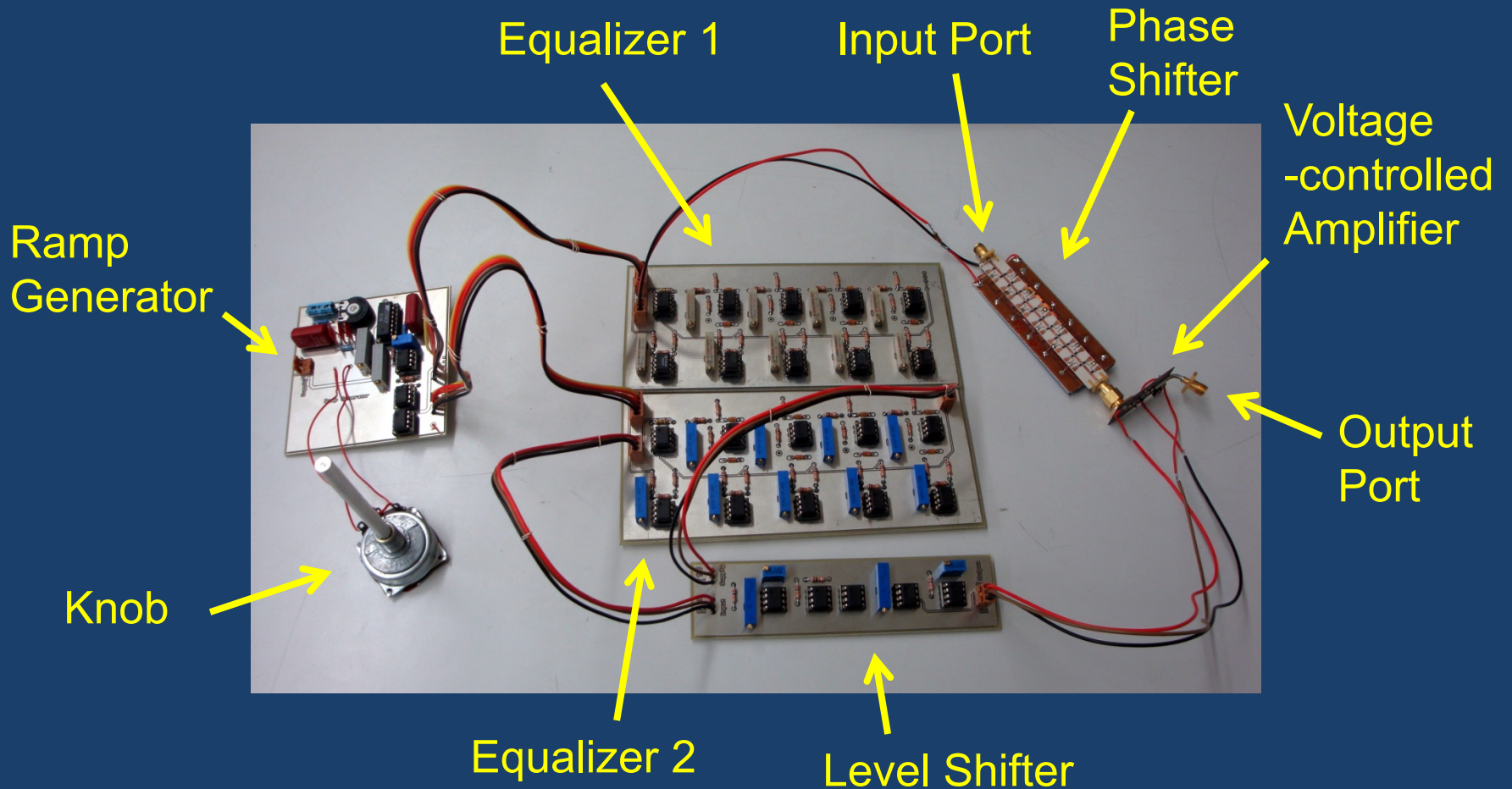
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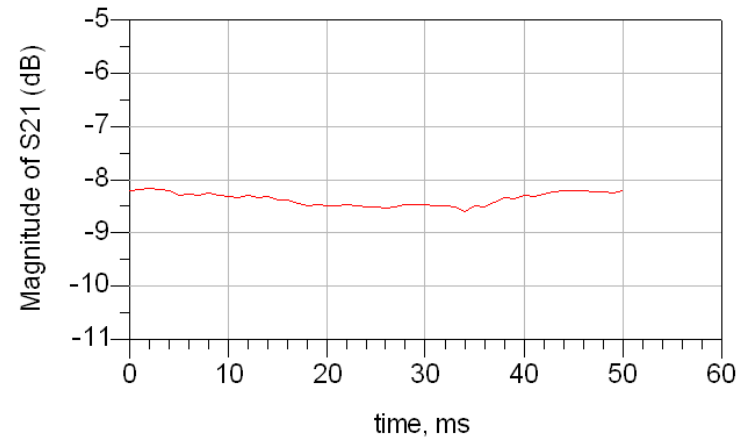
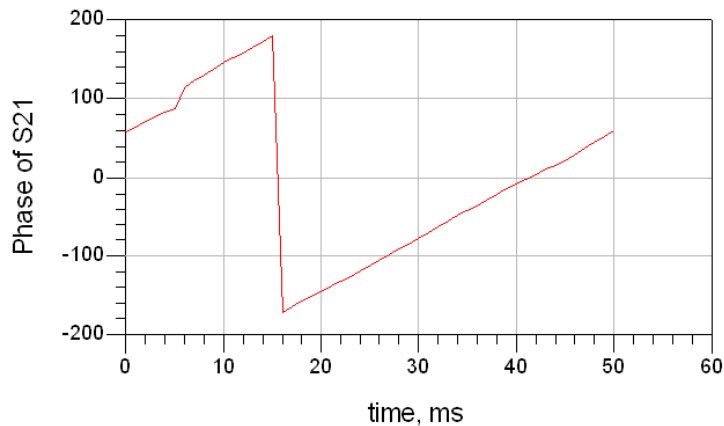


Optimization of the Design



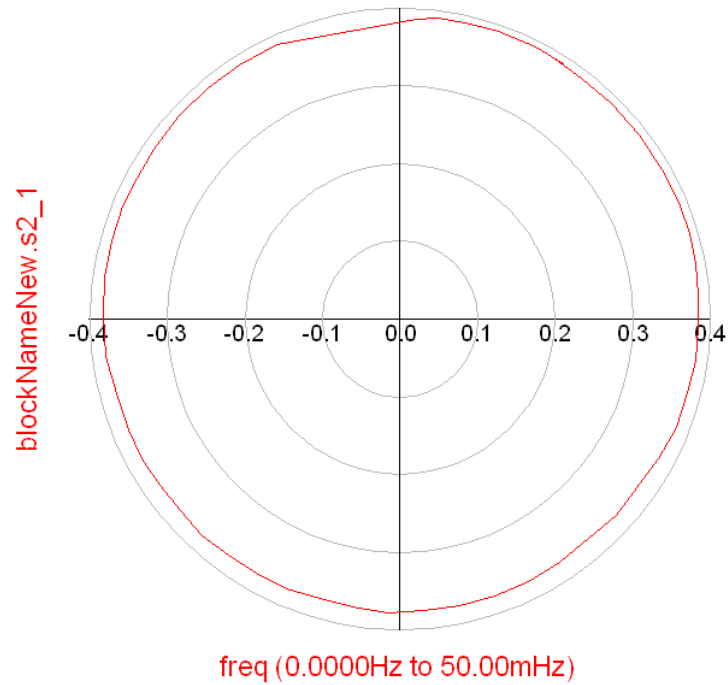
Final Result

- Measurement results at CW mode at simulation velocity 1 km/h



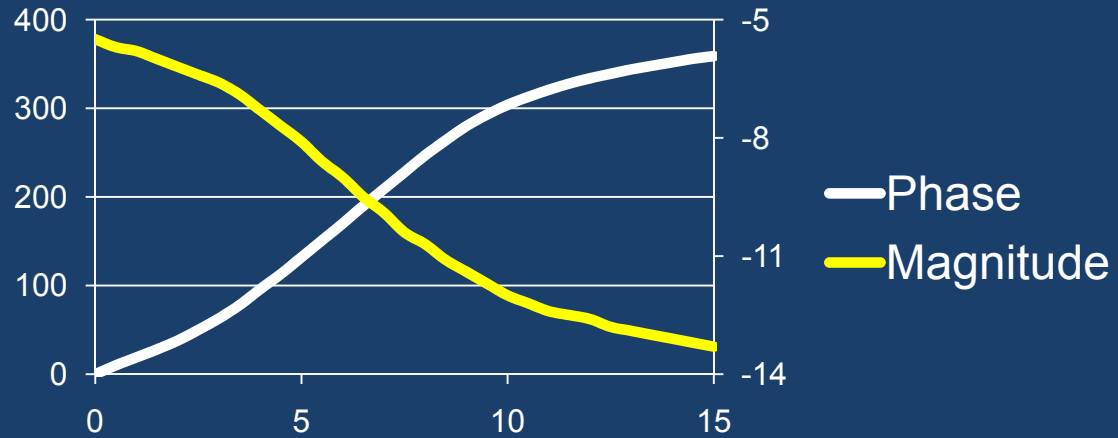
Final Result

Polar representation of measurement result

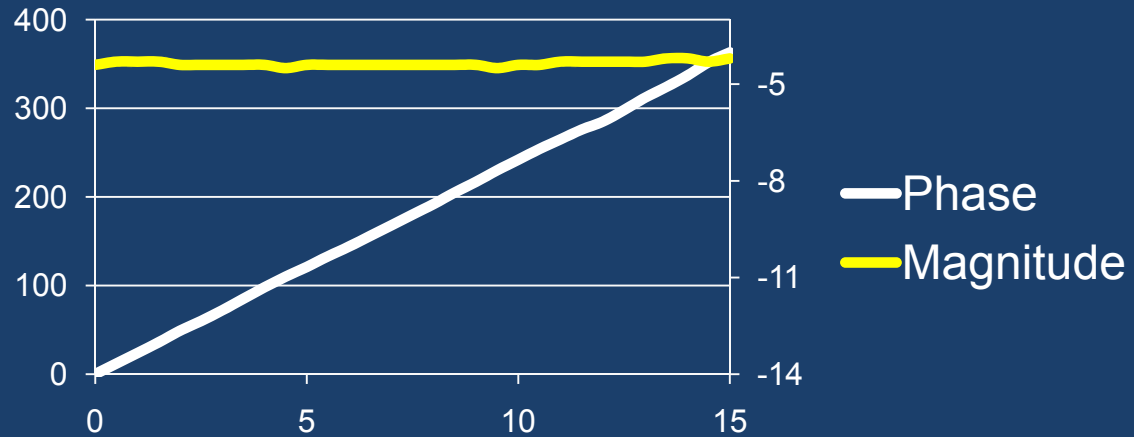


Conclusion

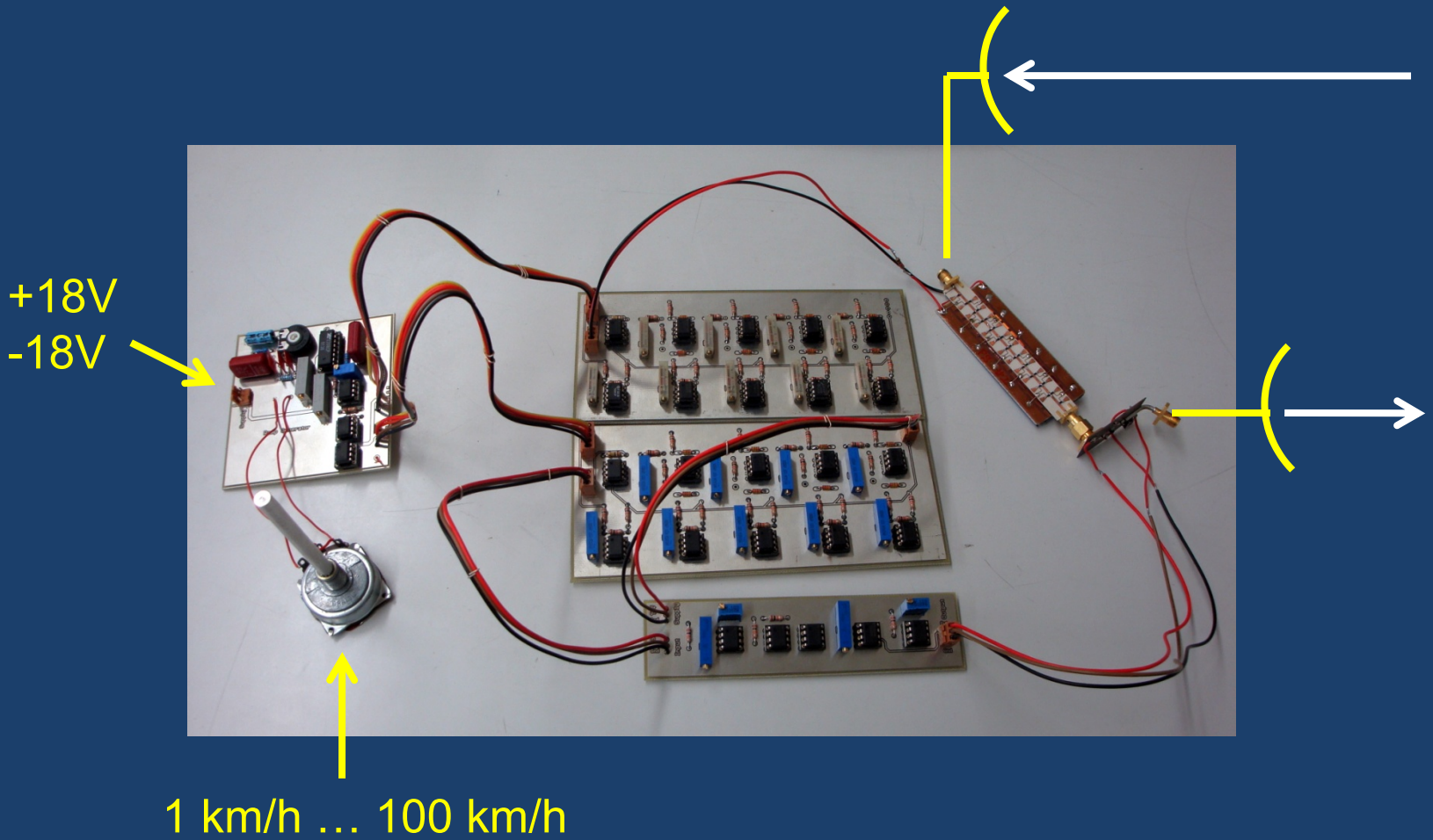
Before:



After:



Conclusion



Thank You for Your attention!