## **Structured Electronic Design**

## EE3C11 Amplifiers: weak nonlinearity

Anton J.M. Montagne

## Static (DC) input-output relation



Intended (specified) linear input-output relation

# intended gain = $\tan \alpha$

 $\longrightarrow$  Input quantity (x)

## Static (DC) input-output relation



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y(x): Input-output relation

 $\longrightarrow$  Input quantity (x)



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 $\longrightarrow$  Input quantity (x)

 $x_i$ : Some input signal excursion

### Operating point and offset



### Intended (specified) linear input-output relation

y(x): Input-output relation

 $\rightarrow$  Input quantity (x)

# Static (DC) input-output relation



Intended (specified) linear input-output relation  $\frac{dy}{dx}$  in  $(x_Q, y_Q)$ : linearized input-output relation

y(x): Input-output relation

 $\longrightarrow$  Input quantity (x)

gain = tan  $\beta$ relative inaccuracy =  $\frac{\tan\beta - \tan\alpha}{\tan\alpha}$ 



 $\frac{dy}{dx} \text{ in } (x_Q, y_Q) \text{: linearized input-output relation}$   $\frac{\text{Nonlinearity at } x_i}{y(x) \text{: Input-output relation}}$ 

 $\longrightarrow$  Input quantity (x)

 $x_i$ : Some input signal excursion from operating point



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 $\gamma \quad y(x)$ : Input-output relation

 $\longrightarrow$  Input quantity (x)

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n 
$$\beta$$
 gain $|_{x=x_i} = \tan \gamma$   
al gain $= \frac{\tan \gamma - \tan \beta}{\tan \beta}$ 

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### Instrumentation

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Characterization as LTD system

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### **Control systems Radio systems** Audio systems Instrumentation

Gain compression Intermodulation distortion

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Radio systems	Audio systems	Control s
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### systems Instrumentation

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Simple relations between description methods exsist for weakly nonlinear, instantaneous systems

See sections: 2.4.7, 2.4.8, 17.5 and 17.6

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