

**Mathematikgleichungen der Hyperbelfunktionen**  
 Siehe: Papula, L., (2003), *Mathematische Formelsammlung*, Vieweg

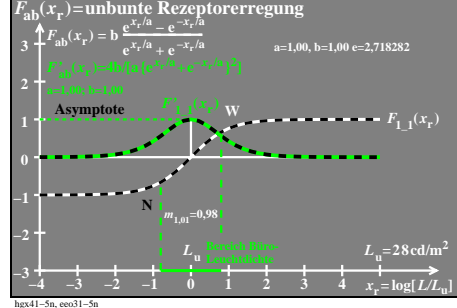
$$F_{ab}(x/a) = b \tanh(x/a) = b \frac{e^{x/a} - e^{-x/a}}{e^{x/a} + e^{-x/a}} = b \frac{u(x/a)}{v(x/a)} \quad [1]$$

$$F'_{ab}(x/a) = b \frac{u'(x/a)v(x/a) - u(x/a)v'(x/a)}{v^2(x/a)} \quad [2]$$

$$F'_{ab}(x/a) = b \frac{v^2(x/a) - u^2(x/a)}{a v^2(x/a)} \quad [3]$$

$$F'_{ab}(x/a) = \frac{4b}{a [e^{x/a} + e^{-x/a}]^2} = \frac{b}{a \cosh^2(x/a)} \quad [4]$$

hgx41-2n, eeo31-2n



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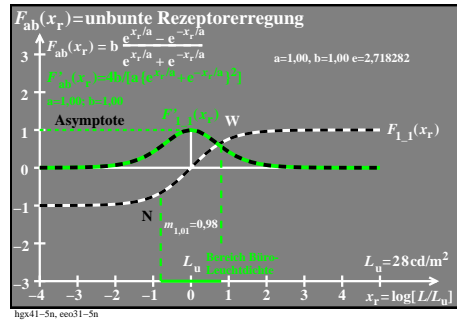
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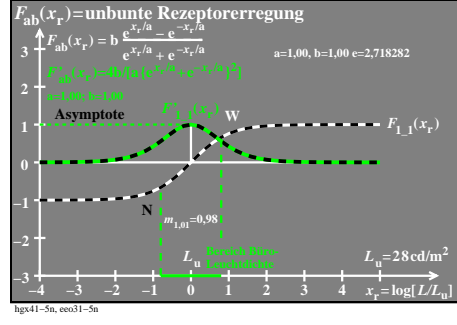
$$F_{ab}(x/a) = b \tanh(x/a) = b \frac{e^{x/a} - e^{-x/a}}{e^{x/a} + e^{-x/a}} \quad [1]$$

$$\frac{dF_{ab}(x/a)}{dx} = \frac{4b}{a [e^{x/a} + e^{-x/a}]^2} = \frac{b}{a \cosh^2(x/a)} \quad [4]$$

$$\frac{dF_{ab}(x_r/a)}{dx_r} = \frac{4b}{a [e^{x_r/a} + e^{-x_r/a}]^2} \frac{dx_r/dL = \ln(10)/L}{L} \quad [5]$$

$$\frac{dF_{ab}(x_r/a)}{dx_r} \frac{dx_r}{dL} = \frac{4b}{a [e^{x_r/a} + e^{-x_r/a}]^2} \frac{\ln(10)}{L} \quad [6]$$

hgx41-6n eeo41-6n



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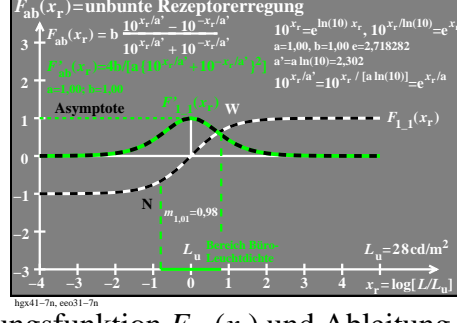
$$F_{ab}(x_r/a) = b \tanh(x_r/a) = b \frac{e^{x_r/a} - e^{-x_r/a}}{e^{x_r/a} + e^{-x_r/a}} \quad [1]$$

$$\frac{dF_{ab}(x_r/a)}{dx_r} = \frac{4b}{a [e^{x_r/a} + e^{-x_r/a}]^2} \frac{dx_r/dL = \ln(10)/L}{L} \quad [5]$$

$$\frac{dF_{ab}(x_r/a)}{dx_r} \frac{dx_r}{dL} = \frac{4b}{a [e^{x_r/a} + e^{-x_r/a}]^2} \frac{\ln(10)}{L} \quad [6]$$

$$\frac{L}{dL} = \frac{4b \ln(10)}{a [e^{x_r/a} + e^{-x_r/a}]^2} \quad dL = \frac{a [e^{x_r/a} + e^{-x_r/a}]^2 L}{4b \ln(10)} \quad [7]$$

hgx41-8n eeo41-8n



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$$F(x/a) = \tanh(x/a) = \frac{e^{x/a} - e^{-x/a}}{e^{x/a} + e^{-x/a}} = \frac{u(x/a)}{v(x/a)} \quad [1]$$

$$F'(x/a) = \frac{u'(x/a)v(x/a) - u(x/a)v'(x/a)}{v^2(x/a)} \quad [2]$$

$$F'(x/a) = \frac{v^2(x/a) - u^2(x/a)}{a v^2(x/a)} \quad [3]$$

$$F'(x/a) = \frac{4}{a [e^{x/a} + e^{-x/a}]^2} = \frac{1}{a \cosh^2(x/a)} \quad [4]$$

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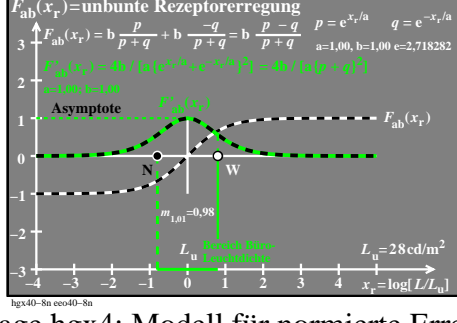
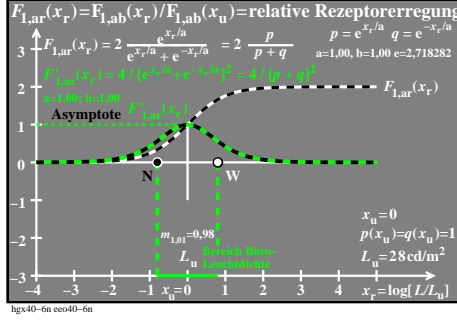
$$F_{ab}(x/a) = b \tanh(x/a) = b \frac{e^{x/a} - e^{-x/a}}{e^{x/a} + e^{-x/a}} = b \frac{u(x/a)}{v(x/a)} \quad [1]$$

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$$F(x) = \tanh(x) = \frac{e^x - e^{-x}}{e^x + e^{-x}} = \frac{u(x)}{v(x)} \quad [1]$$

$$F'(x) = \frac{u'(x)v(x) - u(x)v'(x)}{v^2(x)} = \frac{v^2(x) - u^2(x)}{v^2(x)} \quad [2]$$

$$F'(x) = \frac{[e^x + e^{-x}][e^x + e^{-x}] - [e^x - e^{-x}][e^x - e^{-x}]}{[e^x + e^{-x}]^2} \quad [3]$$

$$F'(x) = \frac{4}{[e^x + e^{-x}]^2} = \frac{1}{\cosh^2(x)} \quad [4]$$

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$$F_{1b}(x) = b \tanh(x) = b \frac{e^x - e^{-x}}{e^x + e^{-x}} = b \frac{u(x)}{v(x)} \quad [1]$$

$$F'_{1b}(x) = b \frac{u'(x)v(x) - u(x)v'(x)}{v^2(x)} \quad [2]$$

$$F'_{1b}(x) = b \frac{v^2(x) - u^2(x)}{a v^2(x)} \quad [3]$$

$$F'_{1b}(x) = \frac{4b}{[e^x + e^{-x}]^2} = \frac{b}{\cosh^2(x)} \quad [4]$$

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