FINITE-SIZE CORRECTIONS FOR 4-POINT PROBE MEASUREMENTS (rev 07Jan04)

With the probes centered on a very wide (lateral dimension d >> s) and very thin (thickness t << s) sample, with s the probe spacing, the resistivity is given by:

$$\rho = \frac{\pi}{\ln(2)} t\left(\frac{V}{I}\right) = 4.5324 t\left(\frac{V}{I}\right)$$

For a sample of finite width and non-negligible thickness this should be multiplied by correction factors f_1 and f_2 :

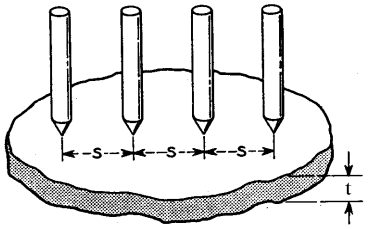
$$\rho = \frac{\pi}{\ln(2)} t\left(\frac{V}{I}\right) f_1 f_2 = 4.5324 t\left(\frac{V}{I}\right) f_1 f_2$$

where

$f_1 = f_1$ (t/s)= finite thickness correction :

$f_1 = f_{11}$ (t/s) = for an insulating bottom boundary

$$f_{11} = \frac{\ln(2)}{\ln\left[\frac{\sinh(t/s)}{\sinh(t/2s)}\right]}$$



in our probe: s=1.59 mm

$f_1 = f_{12}$ (t/s) = for a conducting bottom boundary

$$f_{12} = \frac{\ln(2)}{\ln\left[\frac{\cosh(t/s)}{\cosh(t/2s)}\right]}$$

for t<<s, $f_{11} \approx 1$ and $\rho \approx \frac{\pi}{\ln 2} t\left(\frac{V}{I}\right) f_2 = 4.5324 t\left(\frac{V}{I}\right) f_2$

$f_{12} \approx \frac{8}{3}\ln(2)\frac{s^2}{t^2}$ and $\rho \approx \frac{8\pi}{3}\frac{s^2}{t}\left(\frac{V}{I}\right) f_2$

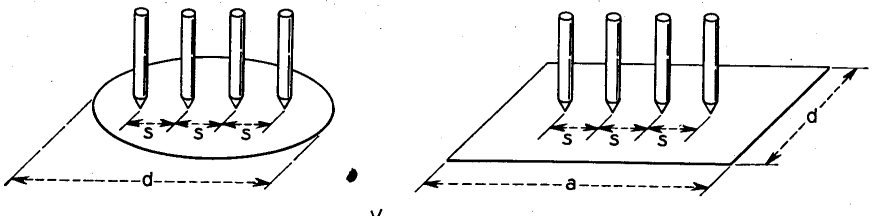
for t>>s, $f_{11} = f_{12} \approx 2\ln(2)\frac{s}{t}$ and $\rho \approx 2\pi\, s\left(\frac{V}{I}\right) f_2$

f_2 = finite width correction :

$f_2 = f_{2C}$ (d/s) = for a circular sample of diameter d

$f_2 = f_{2R}$ (a/d,d/s) = for a rectangular sample of width d and length a

for d/s >> 1, $f_{2C} = f_{2R} \approx 1$

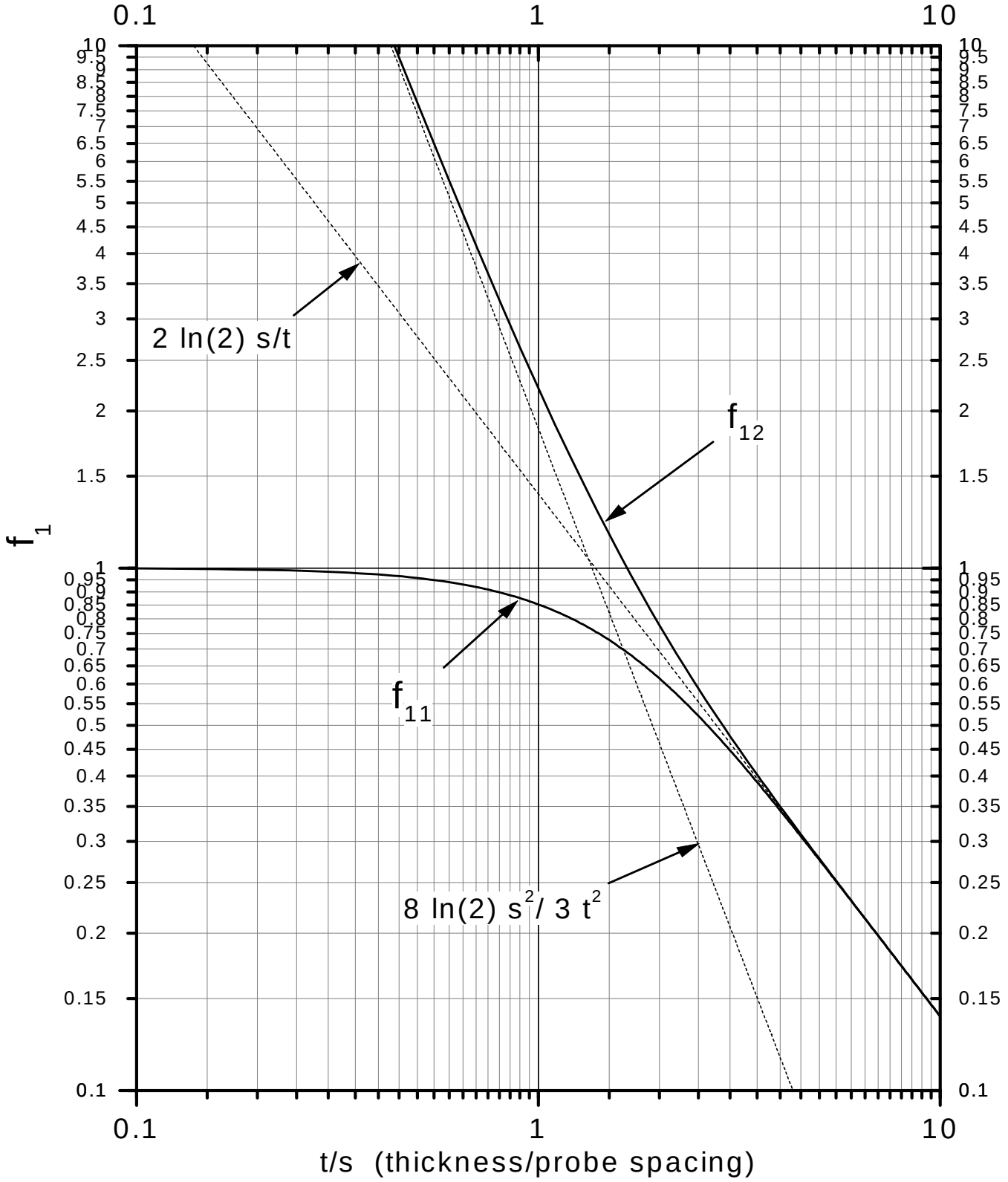


Original references:

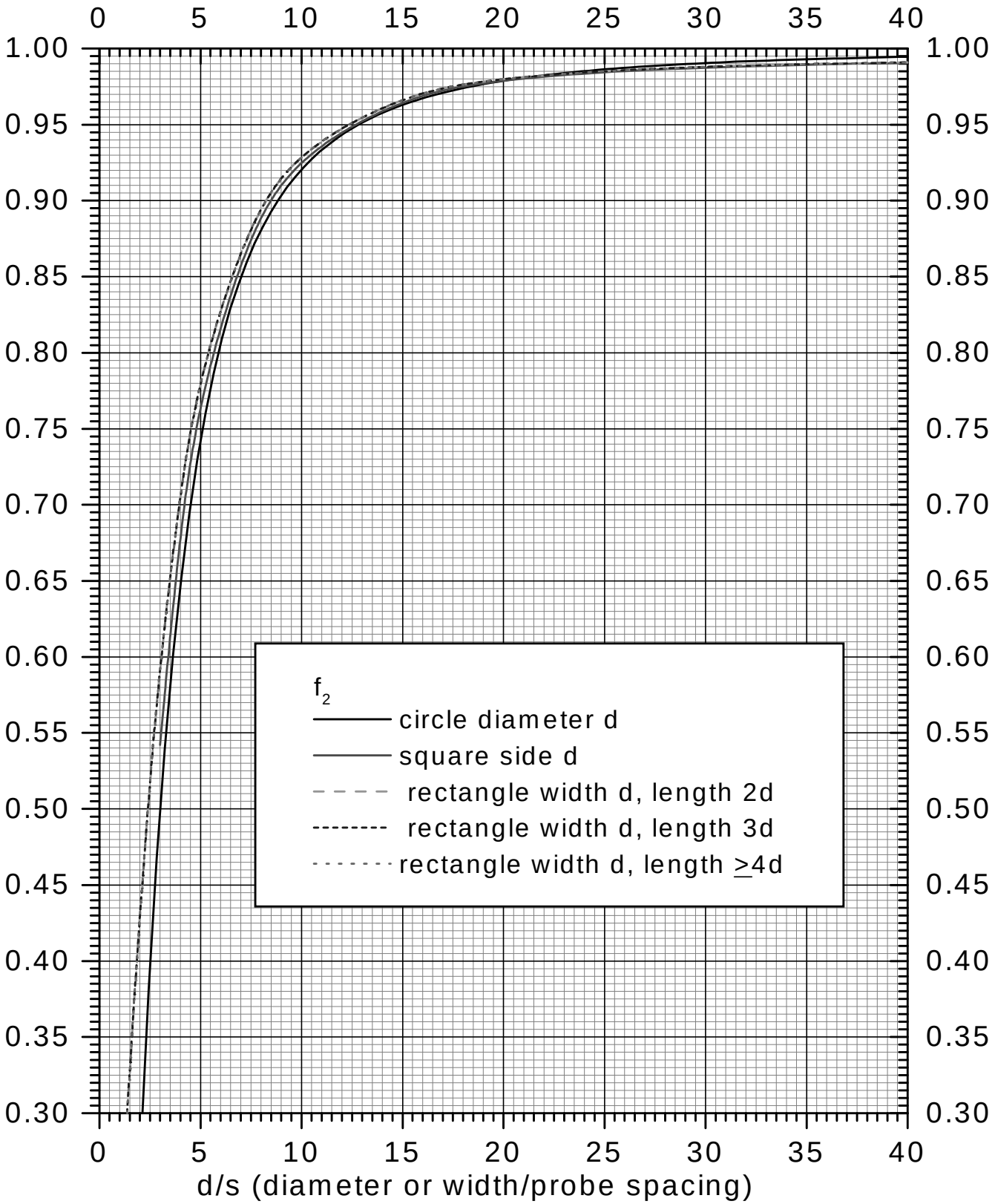
A. Uhlir Jr., The Bell System Technical Journal 34, 105 (1955)
F.M.Smits, The Bell System Technical Journal 37, 711-718 (1958)

More easily accessible reference:

D.K. Schroeder, *Semiconductor Material and Device Characterization*, Wiley 1990.



Source.: F.M.Smits,"Measurement of Sheet Resisitivities with the Four-Point Probe", The Bell System Technical Journal 37, 711-718 (1958)



Source.: F.M.Smits,"Measurement of Sheet Resisitivities with the Four-Point Probe", The Bell System Technical Journal 37, 711-718 (1958)