Manual Analysis – What I want to replicate using Maple

Function:

Y := 1/(R__s + 1/(s*C__dl + 1/(R__ct + 1/(sqrt(s)/sigma + 1/R__w))))

$$Y := \frac{1}{R_s + \frac{1}{s \cdot C_{dl} + \frac{1}{\left(R_{ct} + \left(\frac{1}{\frac{1}{\frac{\text{sigma}}{\text{sqrt}(s)}} + \frac{1}{R_w}}\right)\right)}}}$$

Step 1: Form the pade approximant with the $\sqrt{s}$ variable and order in increasing powers:

$$Y = \frac{\sigma + R_w\sqrt{s} + (R_{ct}+R_w)\sigma \cdot C_{dl} \cdot (\sqrt{s})^2 + R_{ct} \cdot R_w \cdot C_{dl} \cdot (\sqrt{s})^3}{(R_{ct}+R_w+R_s)\sigma + (R_{ct}+R_s)\cdot R_w \cdot \sqrt{s} + (R_{ct}+R_w)\cdot \sigma \cdot C_{dl} \cdot R_s \cdot (\sqrt{s})^2 + R_{ct} \cdot R_w \cdot R_s \cdot C_{dl} \cdot (\sqrt{s})^3}$$

Step 2: Divide through by $(R_{ct}+R_w+R_s)\sigma$ such that 1 appears in the denominator

$$Y = \frac{\frac{1}{(R_{ct}+R_w+R_s)} + \frac{R_w\sqrt{s}}{(R_{ct}+R_w+R_s)\sigma} + \frac{(R_{ct}+R_w)\cdot C_{dl}\cdot(\sqrt{s})^2}{(R_{ct}+R_w+R_s)} + \frac{R_{ct}\cdot R_w \cdot C_{dl}\cdot(\sqrt{s})^3}{(R_{ct}+R_w+R_s)\sigma}}{1 + \frac{(R_{ct}+R_s)\cdot R_w \cdot \sqrt{s}}{(R_{ct}+R_w+R_s)\sigma} + \frac{(R_{ct}+R_w)\cdot C_{dl}\cdot R_s \cdot(\sqrt{s})^2}{(R_{ct}+R_w+R_s)} + \frac{R_{ct}\cdot R_w \cdot R_s \cdot C_{dl}\cdot(\sqrt{s})^3}{(R_{ct}+R_w+R_s)\sigma}}$$

Step 3: This is now of the form

$$Y = \frac{a_0 + a_1(\sqrt{s}) + a_2(\sqrt{s})^2 + a_3(\sqrt{s})^3}{b_0 + b_1(\sqrt{s}) + b_2(\sqrt{s})^2 + b_3(\sqrt{s})^3}$$

Step 4: Solve for the variables Rs, Rct, Cdl and sigma and Rw

$$R_s = \frac{b_3}{a_3} = \frac{b_2}{a_2},\ C_{dl} = \frac{a_3}{b_1}\frac{1}{(\frac{b_1}{a_1} - \frac{b_3}{a_3})},\ R_{ct} = \frac{b_1}{a_1} - \frac{b_3}{a_3},\ \sigma = \frac{a_0}{a_1}\cdot\left(\frac{1}{a_0} - \frac{b_3}{a_3} - \frac{b_1}{a_1} + \frac{b_3}{a_3}\right),\ R_w = \frac{1}{a_0} - \frac{b_3}{a_3} - \frac{b_1}{a_1} + \frac{b_3}{a_3}$$