General Form:

$$ {}_{w}A_{t} = {}_{w}A_{O} \cdot {}_{O}A_{A} \cdot {}_{A}A_{P} \cdot {}_{P}A_{t} $$

B-Axis, single rotational offset in the Y direction, A axis and then the position vector

$$ {}_{w}A_{O} = \begin{matrix} Cb & 0 & -Sb & 0 \\ 0 & 1 & 0 & 0 \\ Sb & 0 & Cb & 0 \\ 0 & 0 & 0 & 1 \end{matrix} \quad {}_{O}A_{A} = \begin{matrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & Dy \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{matrix} $$

$$ {}_{A}A_{P} = \begin{matrix} 1 & 0 & 0 & 0 \\ 0 & Ca & Sa & 0 \\ 0 & -Sa & Ca & 0 \\ 0 & 0 & 0 & 1 \end{matrix} \quad {}_{P}A_{t} = \begin{matrix} 1 & 0 & 0 & Px \\ 0 & 1 & 0 & Py - Dy \\ 0 & 0 & 1 & Pz \\ 0 & 0 & 0 & 1 \end{matrix} $$

Gives:

$$ {}_{w}A_{t} = \begin{matrix} Cb & SaSb & -CaSb & CbPx - SaSb(Dy - Py) - CaSbPz \\ 0 & Ca & Sa & Dy - Ca(Dy - Py) + SaPz \\ Sb & -CbSa & CaCb & BcPx + CbSa(Dy - Py) + CaCbPz \\ 0 & 0 & 0 & 1 \end{matrix} $$

Looking at column 3 where:

$$ K = \begin{matrix} K_x \\ K_y \\ K_z \\ 0 \end{matrix} = \begin{matrix} -CaSb \\ Sa \\ CaCb \\ 0 \end{matrix} $$

Therefore

$$ \theta_A = \sin^{-1} K_y $$

$$ \theta_B = -\tan^{-1} \frac{K_x}{K_z} $$

Looking at the last column as the tool position vector:

$$ Q = \begin{matrix} CbPx - SaSb(Dy - Py) - CaSbPz \\ Dy - Ca(Dy - Py) + SaPz \\ BcPx + CbSa(Dy - Py) + CaCbPz \\ 1 \end{matrix} $$

So I think I'm good up to here…….. I have about 50% confidence in the next step:

$$ Q = \begin{matrix} Q_x \\ Q_y \\ Q_z \\ 1 \end{matrix} = \begin{matrix} Cb & SaSb & -CaSb & -SaSbDy \\ 0 & Ca & Sa & (Ca - 1)Dy \\ Sb & -CbSa & CaCb & CbSaDy \\ 0 & 0 & 0 & 1 \end{matrix} = \begin{matrix} P_x \\ P_y \\ P_z \\ 1 \end{matrix} $$

Which I think should give an inverse matrix of:

$$ \begin{matrix} P_x \\ P_y \\ P_z \\ 1 \end{matrix} = \begin{matrix} Cb & 0 & Sb & 0 \\ SaSb & Ca & -CbSa & -DyCb^2Sa^2 - DySa^2Sb^2 + CaDy(Ca - 1) \\ -CaSb & Sa & CaCb & CaDySaCb^2 + CaDySaSb^2 + SaDy(Ca - 1) \\ 0 & 0 & 0 & 0 \end{matrix} = \begin{matrix} Q_x \\ Q_y \\ Q_z \\ 1 \end{matrix} $$