Derivation for 3rd-order intercept point for two cascaded stages

$OIM_{3T1} = 3 \cdot (P_o - G_2) - 2 \cdot OIP_{31} + G_2$ // Output power intermodulation due to stage 1.

$OIM_{3T1} = 3 \cdot P_o - 2 \cdot OIP_{31} - 2 \cdot G_2$ // Output power intermodulation due to stage 1.

$OIM_{3T2} = 3 \cdot P_o - 2 \cdot OIP_{32}$ // Output power intermodulation due to stage 2.

The composite output intermodulation voltage is

$$OIV_{3T} = 10^{\left(\frac{3 \cdot P_o - 2 \cdot OIP_{31} - 2 \cdot G_2}{20}\right)} + 10^{\left(\frac{3 \cdot P_o - 2 \cdot OIP_{32}}{20}\right)}$$ // Convert to voltages and combine

$$OIV_{3T} = 10^{\frac{3 \cdot P_o}{20}} \left\{ 10^{\left(\frac{-2 \cdot OIP_{31} - 2 \cdot G_2}{20}\right)} + 10^{\left(\frac{-2 \cdot OIP_{32}}{20}\right)} \right\}$$ // Factor out the P_o term

$$OIV_{3T} = 10^{\frac{3 \cdot P_o}{20}} \left\{ 10^{\left(\frac{-(OIP_{31} + G_2)}{10}\right)} + 10^{\left(\frac{-OIP_{32}}{10}\right)} \right\}$$

The composite output intermodulation power is

$OIM_3 = 20 \cdot Log(OIV_{3T})$ // Convert back to power

$$OIM_3 = 3 \cdot P_o + 20 \cdot Log\left\{ 10^{\left(\frac{-(OIP_{31} + G_2)}{10}\right)} + 10^{\left(\frac{-OIP_{32}}{10}\right)} \right\}$$

The effective output intercept point is

$$OIP_3 = \frac{3 \cdot P_o - OIM_3}{2}$$

$$OIP_3 = -10 \cdot Log\left\{ 10^{\left(\frac{-(OIP_{31} + G_2)}{10}\right)} + 10^{\left(\frac{-OIP_{32}}{10}\right)} \right\}$$

Derivation for 2nd-order intercept point for two cascaded stages

$OIM_{2T1} = 2 \cdot (P_o - G_2) - OIP_{21} + G_2$ // Output power intermodulation due to stage 1.

$OIM_{2T1} = 2 \cdot P_o - OIP_{21} - G_2$ // Output power intermodulation due to stage 1.

$OIM_{2T2} = 2 \cdot P_o - OIP_{22}$ // Output power intermodulation due to stage 2.

The composite output intermodulation voltage is

$OIV_{2T} = 10^{\left(\frac{2 \cdot P_o - OIP_{21} - G_2}{20}\right)} + 10^{\left(\frac{2 \cdot P_o - OIP_{22}}{20}\right)}$ // Convert to voltages and combine

$OIV_{2T} = 10^{\frac{2 \cdot P_o}{20}} \left\{ 10^{\left(\frac{-OIP_{21} - G_2}{20}\right)} + 10^{\left(\frac{-OIP_{22}}{20}\right)} \right\}$ // Factor out the P_o term

The composite output intermodulation power is

$OIM_2 = 20 \cdot Log\left(OIV_{2T}\right)$ // Convert back to power

$OIM_2 = 2 \cdot P_o + 20 \cdot Log\left\{ 10^{\left(\frac{-(OIP_{21} + G_2)}{20}\right)} + 10^{\left(\frac{-OIP_{22}}{20}\right)} \right\}$

The effective output intercept point is

$OIP_2 = 2 \cdot P_o - OIM_2$

$OIP_2 = -20 \cdot Log\left\{ 10^{\left(\frac{-(OIP_{21} + G_2)}{20}\right)} + 10^{\left(\frac{-OIP_{22}}{20}\right)} \right\}$