boost
Basic Equations

$$I_{ref}(\theta) = \frac{2P_o \sin(\theta)}{V_{pk}} \tag{1}$$

$$\delta_Q(\theta) = 1 - \frac{V_{pk} \sin(\theta)}{V_o} \tag{2}$$

$$\delta_D(\theta) = \frac{V_{pk} \sin(\theta)}{V_o} \tag{3}$$

$$\tag{4}$$

Bilateral Triangle Δ^B
A = triangle peak-to-peak
DT = time of triangle peak

$$\Delta^B_{rms}(A, B, D, T) = \frac{\sqrt{\int\limits_0^{DT} \left(-\frac{A}{2} + \frac{At}{DT}\right)^2 dt + \int\limits_0^{T(1-D)} \left(-\frac{A}{2} + \frac{At}{T(1-D)}\right)^2 dt}}{\sqrt{T}} \tag{5}$$

$$\Delta^B_{rms}(A, B, D, T) = \frac{A}{2\sqrt{3}} \tag{6}$$

$$\Delta^B_{avg}(A, B, D, T) = \frac{\int\limits_0^{DT} \left(-\frac{A}{2} + \frac{At}{DT}\right) dt + \int\limits_0^{T(1-D)} \left(-\frac{A}{2} + \frac{At}{T(1-D)}\right) dt}{T} \tag{7}$$

$$\Delta^B_{avg}(A, B, D, T) = 0 \tag{8}$$

$$\tag{9}$$

Elevated Right Triangle Δ^R
B = Tri Y Midpoint
A = triangle height

DT = time of triangle peak

$$\Delta_{rms}^{R}(A,B,D,T) = \frac{\sqrt{\int\limits_{0}^{DT} \left(- \frac{A}{2} + \frac{At}{DT} + B\right)^{2}\, dt}}{\sqrt{T}} \tag{10}$$

$$\Delta_{rms}^{R}(A,B,D,T) = \frac{\sqrt{D} \sqrt{A^{2} + 12 B^{2}}}{2 \sqrt{3}} \tag{11}$$

$$\Delta_{avg}^{R}(A,B,D,T) = \frac{\int\limits_{0}^{DT} \left(- \frac{A}{2} + \frac{At}{DT} + B\right)\, dt}{T} \tag{12}$$

$$\Delta_{avg}^{R}(A,B,D,T) = BD \tag{13}$$

$$\tag{14}$$

Inductor rms simple

$$I_{ref,rms} = \frac{\sqrt{\int\limits_{0}^{\pi} \frac{4 P_{o}^{2} \sin^{2}{\left(\theta \right)}}{V_{pk}^{2}}\, d\theta}}{\sqrt{\pi}} \tag{15}$$

$$I_{ref,rms} = \frac{\sqrt{2} P_{o}}{V_{pk}} \tag{16}$$

$$I_{L,rms} = I_{ref,rms} \tag{17}$$

$$\tag{18}$$

Inductor rms with ripple

$$\Delta i_{L,pp}(\theta) = v_{In}(\theta)\frac{\delta_Q(\theta)}{Lf} \tag{19}$$

$$\Delta i_{L,pp}(\theta) = \frac{V_{pk}\left(1 - \frac{V_{pk}\sin(\theta)}{V_o}\right)\sin(\theta)}{Lf} \tag{20}$$

$$\Delta i_{L,rms,t}(\theta) = \Delta^B_{rms}(A = i_{LR,pp}) \tag{21}$$

$$\Delta i_{L,rms,t}(\theta) = \frac{V_{pk}\left|V_o - V_{pk}\sin(\theta)\right|\left|\sin(\theta)\right|}{2\sqrt{3}LV_of} \tag{22}$$

$$\Delta I_{L,rms} = \frac{\sqrt{\int\limits_0^\pi \frac{V_{pk}^2\left(V_o - V_{pk}\sin(\theta)\right)^2\sin^2(\theta)}{12L^2V_o^2f^2}\,d\theta}}{\sqrt{\pi}} \tag{23}$$

$$\Delta I_{L,rms} = \frac{V_{pk}\sqrt{12\pi V_o^2 - 64V_oV_{pk} + 9\pi V_{pk}^2}}{12\sqrt{2}\sqrt{\pi}LV_of} \tag{24}$$

$$I_{L,rms} = \sqrt{I_{ref,rms}^2 + \Delta I_{L,rms}^2} \tag{25}$$

$$I_{L,rms} = \frac{\sqrt{576\pi L^2P_o^2V_o^2f^2 + 12\pi V_o^2V_{pk}^4 - 64V_oV_{pk}^5 + 9\pi V_{pk}^6}}{12\sqrt{2}\sqrt{\pi}LV_oV_{pk}f} \tag{26}$$

$$\tag{27}$$

Bridge rms simple

$$I_{B,rms} = I_{L,rms} \tag{28}$$

$$I_{B,rms} = \frac{\sqrt{2}P_o}{V_{pk}} \tag{29}$$

$$\tag{30}$$

Bridge rms with ripple

$$I_{B,rms} = I_{L,rms} \tag{31}$$

$$I_{B,rms} = \frac{\sqrt{576\pi L^2P_o^2V_o^2f^2 + 12\pi V_o^2V_{pk}^4 - 64V_oV_{pk}^5 + 9\pi V_{pk}^6}}{12\sqrt{2}\sqrt{\pi}LV_oV_{pk}f} \tag{32}$$

$$\tag{33}$$

Bridge avg

$$I_{B,avg} = \frac{\int_{0}^{\pi} \frac{2P_o \sin(\theta)}{V_{pk}}\, d\theta}{\pi} \tag{34}$$

$$I_{B,avg} = \frac{4P_o}{\pi V_{pk}} \tag{35}$$

$$\tag{36}$$

Switch rms simple

$$i_{Q,rms,t}(\theta) = \Delta^{R}_{rms}\big(B = i_{ref}, A = 0, D = \delta_Q\big) \tag{37}$$

$$i_{Q,rms,t}(\theta) = \frac{2P_o\sqrt{V_o - V_{pk}\sin(\theta)}\,|\sin(\theta)|}{\sqrt{V_o}V_{pk}} \tag{38}$$

$$I_{Q,rms} = \frac{\sqrt{\int_{0}^{\pi} \frac{4P_o^2\left(V_o - V_{pk}\sin(\theta)\right)\sin^2(\theta)}{V_o V_{pk}^2}\, d\theta}}{\sqrt{\pi}} \tag{39}$$

$$I_{Q,rms} = \frac{P_o\sqrt{6\pi V_o - 16V_{pk}}}{\sqrt{3}\sqrt{\pi}\sqrt{V_o}V_{pk}} \tag{40}$$

$$\tag{41}$$

Switch rms with ripple

$$i_{Q,rms,t}(\theta) = \Delta^{R}_{rms}\big(B = i_{ref}, A = i_{LR,pp}, D = \delta_Q\big) \tag{42}$$

$$i_{Q,rms,t}(\theta) = \frac{\sqrt{(V_o - V_{pk}\sin(\theta))\left(48L^2P_o^2V_o^2f^2 + V_o^2V_{pk}^4 - 2V_oV_{pk}^5\sin(\theta) + V_{pk}^6\sin^2(\theta)\right)}\,|\sin(\theta)|}{2\sqrt{3}LV_o^{\frac{3}{2}}V_{pk}f} \tag{43}$$

$$I_{Q,rms} = \frac{\sqrt{\int\limits_0^{\pi} \frac{\left(V_o - V_{pk}\sin(\theta)\right)\left(48L^2P_o^2V_o^2f^2 + V_o^2V_{pk}^4 - 2V_oV_{pk}^5\sin(\theta) + V_{pk}^6\sin^2(\theta)\right)\sin^2(\theta)}{12L^2V_o^3V_{pk}^2f^2}\,d\theta}}{\sqrt{\pi}} \tag{44}$$

$$I_{Q,rms} = \frac{\sqrt{2880\pi L^2P_o^2V_o^3f^2 - 7680L^2P_o^2V_o^2V_{pk}f^2 + 60\pi V_o^3V_{pk}^4 - 480V_o^2V_{pk}^5 + 135\pi V_oV_{pk}^6 - 128V_{pk}^7}}{12\sqrt{10}\sqrt{\pi}LV_o^{\frac{3}{2}}V_{pk}f} \tag{45}$$

$$\tag{46}$$

Switch avg

$$i_{Q,avg,t}(\theta) = \Delta^{R}_{avg}\big(B = i_{ref}, D = \delta_Q\big) \tag{47}$$

$$I_{Q,avg,t} = \frac{2P_o\,|V_o - V_{pk}\sin(\theta)|\,|\sin(\theta)|}{V_oV_{pk}} \tag{48}$$

$$I_{Q,avg} = \frac{\int\limits_0^{\pi} \frac{2P_o\left(1 - \frac{V_{pk}\sin(\theta)}{V_o}\right)\sin(\theta)}{V_{pk}}\,d\theta}{\pi} \tag{49}$$

$$I_{Q,avg} = \frac{P_o\,|4V_o - \pi V_{pk}|}{\pi V_oV_{pk}} \tag{50}$$

$$\tag{51}$$

Switch switching loss timings

$$t_{IR} = t_2 - t_1 = R_g C_{iss,test} \ln\left(\frac{V_{gs,max} - V_{th}}{V_{gs,max} - V_{gp}}\right) \tag{52}$$

$$t_{VF} = t_3 = \frac{R_g Q_{gd,test} V_{ds,max}}{V_{ds,test}(V_{gs,max} - V_{gp})} \tag{53}$$

$$t_{VR} = t_5 = \frac{R_g Q_{gd,test} V_{ds,max}}{V_{ds,test} V_{gp}} \tag{54}$$

$$t_{IF} = t_6 = R_g C_{iss,test} \ln\left(\frac{V_{gp}}{V_{th}}\right) \tag{55}$$

$$t_{ON} = t_{IR} + t_{VF} \tag{56}$$

$$t_{OFF} = t_{IF} + t_{VR} \tag{57}$$

$$\tag{58}$$

Switch switching loss simple

$$P_{Q,sw,t}(\theta) = \frac{V_o f}{2} I_{ref}(\theta)(t_{ON} + t_{OFF}) \tag{59}$$

$$P_{Q,sw,t}(\theta) = \frac{P_o V_o f\left(T_{OFF} + T_{ON}\right)\left|\sin\left(\theta\right)\right|}{V_{pk}} \tag{60}$$

$$P_{Q,sw} = \frac{\int\limits_0^\pi \frac{P_o V_o f\left(T_{OFF} + T_{ON}\right)\left|\sin\left(\theta\right)\right|}{V_{pk}}\, d\theta}{\pi} \tag{61}$$

$$P_{Q,sw} = \frac{2 P_o V_o f\left(T_{OFF} + T_{ON}\right)}{\pi V_{pk}} \tag{62}$$

$$\tag{63}$$

Switch switching loss with ripple

$$P_{Q,sw,t}(\theta) = \frac{V_o f}{2}\left(\big(I_{ref}(\theta) - \Delta i_{L,pp}(\theta)\big)t_{ON} + \big(I_{ref}(\theta) + \Delta i_{L,pp}(\theta)\big)t_{OFF}\right) \tag{64}$$

$$P_{Q,sw,t}(\theta) = \frac{V_o f\left(T_{OFF}\left(\frac{2P_o\sin(\theta)}{V_{pk}} + \frac{V_{pk}\left(1 - \frac{V_{pk}\sin(\theta)}{V_o}\right)\sin(\theta)}{2Lf}\right) + T_{ON}\left(\frac{2P_o\sin(\theta)}{V_{pk}} - \frac{V_{pk}\left(1 - \frac{V_{pk}\sin(\theta)}{V_o}\right)\sin(\theta)}{2Lf}\right)\right)}{2} \tag{65}$$

$$P_{Q,sw} = \frac{\int\limits_0^\pi \frac{V_o f\left(T_{OFF}\left(\frac{2P_o\sin(\theta)}{V_{pk}} + \frac{V_{pk}\left(1 - \frac{V_{pk}\sin(\theta)}{V_o}\right)\sin(\theta)}{2Lf}\right) + T_{ON}\left(\frac{2P_o\sin(\theta)}{V_{pk}} - \frac{V_{pk}\left(1 - \frac{V_{pk}\sin(\theta)}{V_o}\right)\sin(\theta)}{2Lf}\right)\right)}{2}\, d\theta}{\pi} \tag{66}$$

(67)

$$P_{Q,sw} = \frac{\left|16LP_oT_{OFF}V_of + 16LP_oT_{ON}V_of + 4T_{OFF}V_oV_{pk}^2 - \pi T_{OFF}V_{pk}^3 - 4T_{ON}V_oV_{pk}^2 + \pi T_{ON}V_{pk}^3\right|}{8\pi LV_{pk}} \tag{68}$$

(69)

Switch switching loss output capacitance

$$P_{Q,sw,c}(\theta) = \frac{C_{oss}V_o^2 f}{2} \tag{70}$$

$$P_{Q,sw,c} = \frac{\int\limits_0^\pi \frac{C_{oss}V_o^2 f}{2}\, d\theta}{\pi} \tag{71}$$

$$P_{Q,sw,c} = \frac{C_{oss}V_o^2 f}{2} \tag{72}$$

(73)

Boost Diode simple

$$i_{D,rms,t}(\theta) = \Delta^{R}_{rms}\big(B = i_{ref}, A = 0, D = \delta_D\big) \tag{74}$$

$$i_{D,rms,t}(\theta) = \frac{2P_o\sqrt{\sin^3(\theta)}}{\sqrt{V_o}\sqrt{V_{pk}}} \tag{75}$$

$$I_{D,rms} = \frac{\sqrt{\int\limits_0^{\pi} \frac{4P_o^2\sin^3(\theta)}{V_oV_{pk}}\,d\theta}}{\sqrt{\pi}} \tag{76}$$

$$I_{D,rms} = \frac{4P_o}{\sqrt{3}\sqrt{\pi}\sqrt{V_o}\sqrt{V_{pk}}} \tag{77}$$

$$\tag{78}$$

Boost Diode with ripple

$$i_{D,rms,t}(\theta) = \Delta^{R}_{rms}\big(B = i_{ref}, A = i_{LR,pp}, D = \delta_D\big) \tag{79}$$

$$i_{D,rms,t}(\theta) = \frac{\sqrt{\left(48L^2P_o^2V_o^2f^2 + V_o^2V_{pk}^4 - 2V_oV_{pk}^5\sin(\theta) + V_{pk}^6\sin^2(\theta)\right)\sin^3(\theta)}}{2\sqrt{3}LV_o^{\frac{3}{2}}\sqrt{V_{pk}}f} \tag{80}$$

$$I_{D,rms} = \frac{\sqrt{\int\limits_0^{\pi} \frac{\left(48L^2P_o^2V_o^2f^2 + V_o^2V_{pk}^4 - 2V_oV_{pk}^5\sin(\theta) + V_{pk}^6\sin^2(\theta)\right)\sin^3(\theta)}{12L^2V_o^3V_{pk}f^2}\,d\theta}}{\sqrt{\pi}} \tag{81}$$

$$I_{D,rms} = \frac{\sqrt{3840L^2P_o^2V_o^2f^2 + 80V_o^2V_{pk}^4 - 45\pi V_oV_{pk}^5 + 64V_{pk}^6}}{12\sqrt{5}\sqrt{\pi}LV_o^{\frac{3}{2}}\sqrt{V_{pk}}f} \tag{82}$$

$$\tag{83}$$

Boost Diode avg

$$i_{D,avg,t}(\theta) = \Delta^{R}_{avg}\big(B = i_{ref}, D = \delta_D\big) \tag{84}$$

$$I_{D,avg,t} = \frac{2P_o\sin^2(\theta)}{V_o} \tag{85}$$

$$I_{D,avg} = \frac{\int\limits_0^{\pi} \frac{2P_o\sin^2(\theta)}{V_o}\,d\theta}{\pi} \tag{86}$$

$$I_{D,avg} = \frac{P_o}{V_o} \tag{87}$$

$$\tag{88}$$

Boost Diode switching loss timings

$$K_Q = \frac{I_{rr,0} T_{rr,0}}{2\sqrt{I_{F,0}}} \tag{89}$$

$$S = \frac{T_{rr,0} \frac{dI_{D,0}}{dt}}{I_{rr,0}} - 1 \tag{90}$$

$$I_{rr} = \sqrt{\frac{2 \frac{dI_D}{dt} K_Q \sqrt{I_F}}{1+S}} \tag{91}$$

$$T_a = \frac{I_{rr}}{\frac{dI_D}{dt}} \tag{92}$$

$$T_b = S T_a \tag{93}$$

$$E_Q = V_{DS} \big(\frac{I_{rr}}{2} T_a + \frac{I_{rr}}{4} T_b \big) \tag{94}$$

$$E_D = \frac{V_R I_{rr}}{4} T_b \tag{95}$$

$$\tag{96}$$

Boost Diode switching loss reverse recovery simple

$$I_F = \frac{2P_o \sin(\theta)}{V_{pk}} \tag{97}$$

$$\frac{dI_D}{dt} = \frac{2P_o \sin(\theta)}{T_{IR} V_{pk}} \tag{98}$$

$$I_{rr} = \frac{2\sqrt[4]{2}\sqrt{K_Q} P_o^{\frac{3}{4}} \sqrt{\sin^{\frac{3}{2}}(\theta)}}{\sqrt{T_{IR}} V_{pk}^{\frac{3}{4}} \sqrt{S+1}} \tag{99}$$

$$T_a = \frac{\sqrt[4]{2}\sqrt{K_Q}\sqrt{T_{IR}}\sqrt[4]{V_{pk}}\sqrt{\sin^{\frac{3}{2}}(\theta)}}{\sqrt[4]{P_o}\sqrt{S+1}\sin(\theta)} \tag{100}$$

$$T_b = \frac{\sqrt[4]{2}\sqrt{K_Q} S \sqrt{T_{IR}}\sqrt[4]{V_{pk}}\sqrt{\sin^{\frac{3}{2}}(\theta)}}{\sqrt[4]{P_o}\sqrt{S+1}\sin(\theta)} \tag{101}$$

$$E_{Qrr} = \frac{\sqrt{2} K_Q \sqrt{P_o} V_o (S+2)\sqrt{\sin(\theta)}}{2\sqrt{V_{pk}}(S+1)} \tag{102}$$

$$E_{Drr} = \frac{\sqrt{2} K_Q \sqrt{P_o} S V_o \sqrt{\sin(\theta)}}{2\sqrt{V_{pk}}(S+1)} \tag{103}$$

$$P_{D,sw,rr}(\theta) = \frac{\sqrt{2} K_Q \sqrt{P_o} V_o f \sqrt{\sin(\theta)}}{\sqrt{V_{pk}}} \tag{104}$$

$$P_{D,sw,rr} = \frac{\int\limits_0^{\pi} \frac{\sqrt{2} K_Q \sqrt{P_o} V_o f \sqrt{\sin(\theta)}}{\sqrt{V_{pk}}}\, d\theta}{\pi} \tag{105}$$

$$P_{D,sw,rr} = \frac{\sqrt{2} K_Q \sqrt{P_o} V_o f \int\limits_0^{\pi} \left(1 - \frac{\left(\theta - \frac{\pi}{2}\right)^2}{4}\right) d\theta}{\pi\sqrt{V_{pk}}} \tag{106}$$

$$P_{D,sw,rr} = \frac{K_Q \sqrt{P_o} V_o f \left(48 - \pi^2\right)}{24\sqrt{2}\sqrt{V_{pk}}} \tag{107}$$

$$\tag{108}$$

Boost Diode switching loss reverse recovery with ripple

$$I_F = \frac{2P_o \sin(\theta)}{V_{pk}} - \frac{V_{pk}\left(1 - \frac{V_{pk}\sin(\theta)}{V_o}\right)\sin(\theta)}{2Lf} \tag{109}$$

$$\frac{dI_D}{dt} = \frac{\frac{2P_o \sin(\theta)}{V_{pk}} - \frac{V_{pk}\left(1 - \frac{V_{pk}\sin(\theta)}{V_o}\right)\sin(\theta)}{2Lf}}{T_{IR}} \tag{110}$$

$$I_{rr} = \frac{\sqrt{2}\sqrt{K_Q}\sqrt{\left(\frac{2P_o \sin(\theta)}{V_{pk}} - \frac{V_{pk}\left(1 - \frac{V_{pk}\sin(\theta)}{V_o}\right)\sin(\theta)}{2Lf}\right)^{\frac{3}{2}}}}{\sqrt{T_{IR}}\sqrt{S+1}} \tag{111}$$

$$T_a = \frac{\sqrt{2}\sqrt{K_Q}\sqrt{T_{IR}}\sqrt{\left(\frac{2P_o \sin(\theta)}{V_{pk}} - \frac{V_{pk}\left(1 - \frac{V_{pk}\sin(\theta)}{V_o}\right)\sin(\theta)}{2Lf}\right)^{\frac{3}{2}}}}{\sqrt{S+1}\left(\frac{2P_o \sin(\theta)}{V_{pk}} - \frac{V_{pk}\left(1 - \frac{V_{pk}\sin(\theta)}{V_o}\right)\sin(\theta)}{2Lf}\right)} \tag{112}$$

$$T_b = \frac{\sqrt{2}\sqrt{K_Q}S\sqrt{T_{IR}}\sqrt{\left(\frac{2P_o \sin(\theta)}{V_{pk}} - \frac{V_{pk}\left(1 - \frac{V_{pk}\sin(\theta)}{V_o}\right)\sin(\theta)}{2Lf}\right)^{\frac{3}{2}}}}{\sqrt{S+1}\left(\frac{2P_o \sin(\theta)}{V_{pk}} - \frac{V_{pk}\left(1 - \frac{V_{pk}\sin(\theta)}{V_o}\right)\sin(\theta)}{2Lf}\right)} \tag{113}$$

$$E_{Qrr} = \frac{\sqrt{2}K_Q\sqrt{V_o}\sqrt{\left(4LP_oV_of - V_oV_{pk}^2 + V_{pk}^3\sin(\theta)\right)\sin(\theta)}\,(S+2)}{4\sqrt{L}\sqrt{V_{pk}}\sqrt{f}\,(S+1)} \tag{114}$$

$$E_{Drr} = \frac{\sqrt{2}K_QS\sqrt{V_o}\sqrt{\left(4LP_oV_of - V_{pk}^2\left(V_o - V_{pk}\sin(\theta)\right)\right)\sin(\theta)}}{4\sqrt{L}\sqrt{V_{pk}}\sqrt{f}\,(S+1)} \tag{115}$$

$$\tag{116}$$

$$P_{D,sw,rr}(\theta) = \frac{\sqrt{2}K_Q\sqrt{V_o}\sqrt{f}\sqrt{\left(4LP_oV_of - V_oV_{pk}^2 + V_{pk}^3\sin(\theta)\right)\sin(\theta)}}{2\sqrt{L}\sqrt{V_{pk}}} \tag{117}$$

$$P_{D,sw,rr} = \frac{\int\limits_0^\pi \frac{\sqrt{2}K_Q\sqrt{V_o}\sqrt{f}\sqrt{\left(4LP_oV_of - V_oV_{pk}^2 + V_{pk}^3\sin(\theta)\right)\sin(\theta)}}{2\sqrt{L}\sqrt{V_{pk}}}\, d\theta}{\pi} \tag{118}$$

$$P_{D,sw,rr} = \frac{\sqrt{2}K_Q\sqrt{V_o}\sqrt{f}\int\limits_0^\pi \left(-\frac{\left(\theta-\frac{\pi}{2}\right)^2\left(4LP_oV_of - V_oV_{pk}^2 + 2V_{pk}^3\right)}{4\sqrt{4LP_oV_of - V_oV_{pk}^2 + V_{pk}^3}} + \sqrt{4LP_oV_of - V_oV_{pk}^2 + V_{pk}^3}\right) d\theta}{2\pi\sqrt{L}\sqrt{V_{pk}}} \tag{119}$$

$$P_{D,sw,rr} = \frac{K_Q\sqrt{V_o}\sqrt{f}\left|-4\pi^2LP_oV_of + 192LP_oV_of - 48V_oV_{pk}^2 + \pi^2V_oV_{pk}^2 - 2\pi^2V_{pk}^3 + 48V_{pk}^3\right|}{48\sqrt{2}\sqrt{L}\sqrt{V_{pk}}\sqrt{4LP_oV_of - V_oV_{pk}^2 + V_{pk}^3}} \tag{120}$$

$$\tag{121}$$

Boost Diode switching loss junction capacitance

$$P_{D,sw,c}(\theta) = \frac{C_jV_{D,bl}^2(\theta)f}{2} \tag{122}$$

$$P_{D,sw,c}(\theta) = \frac{C_jV_o^2f}{2} \tag{123}$$

$$P_{D,sw,c} = \frac{\int\limits_0^\pi \frac{C_jV_o^2f}{2}\, d\theta}{\pi} \tag{124}$$

$$P_{D,sw,c} = \frac{C_jV_o^2f}{2} \tag{125}$$

$$\tag{126}$$

Cap rms simple

$$I_{C,rms} = \sqrt{I_{D,rms}^2 - (\frac{P_o}{V_o})^2} \tag{127}$$

$$I_{C,rms} = \frac{P_o\sqrt{16V_o - 3\pi V_{pk}}}{\sqrt{3}\sqrt{\pi}V_o\sqrt{V_{pk}}} \tag{128}$$

$$\tag{129}$$

Cap rms with ripple

$$I_{C,rms} = \sqrt{I_{D,rms}^2 - (\frac{P_o}{V_o})^2} \tag{130}$$

$$I_{C,rms} = \frac{\sqrt{3840L^2P_o^2V_o^2f^2 - 720\pi L^2P_o^2V_oV_{pk}f^2 + 80V_o^2V_{pk}^4 - 45\pi V_oV_{pk}^5 + 64V_{pk}^6}}{12\sqrt{5}\sqrt{\pi}LV_o^{\frac{3}{2}}\sqrt{V_{pk}}f} \tag{131}$$

$$\tag{132}$$