

Performance Parameters

$$FormFactor = \frac{V_{rms}}{V_{avg}}$$

$$CrestFactor = \frac{V_{peak}}{V_{rms}}$$

$$DistortionFactor = \frac{I_{1rms}}{I_{rms}}$$

ϕ : phase difference between fundamentals of current and voltage

$$DisplacementPowerFactor = \cos(\phi)$$

$$TruePowerFactor = \frac{P}{S} = DPF \frac{I_{1,RMS}}{I_{RMS}}$$

$$THD = \sqrt{\left(\frac{I_{rms}}{I_{1rms}}\right)^2 - 1}$$

Symmetry	Condition Required	a_h and b_h	
Even	$f(-t) = f(t)$	$b_h = 0$	$a_h = \frac{2}{\pi} \int_0^{\pi} f(t) \cos(h\omega t) d(\omega t)$
Odd	$f(-t) = -f(t)$	$a_h = 0$	$b_h = \frac{2}{\pi} \int_0^{\pi} f(t) \sin(h\omega t) d(\omega t)$
Half-wave	$f(t) = -f(t + \frac{1}{2}T)$	$a_h = b_h = 0$ for even h	$a_h = \frac{2}{\pi} \int_0^{\pi} f(t) \cos(h\omega t) d(\omega t)$ for odd h $b_h = \frac{2}{\pi} \int_0^{\pi} f(t) \sin(h\omega t) d(\omega t)$ for odd h

Figure 1: Fourier Transform Table

Switch Selection

Peak Switch Current

$$\hat{I}_{sw} = \frac{1}{(1-D)} \frac{N_2}{N_1} I_o + \frac{N_1}{N_2} \frac{(1-D)T_s}{2L_m} V_o$$

Peak Switch Voltage

$$\hat{V}_{sw} = V_d + \frac{N_1}{N_2} V_o = \frac{V_d}{(1-D)}$$

Figure 2: Flyback switch considerations

$$\begin{aligned} V_o &= V_s \left(\frac{D}{1-D} \right) \left(\frac{N_2}{N_1} \right) & \frac{\Delta V_o}{V_o} &= \frac{D}{RCf} & (L_m)_{min} &= \frac{(1-D)^2 R \left(\frac{N_1}{N_2} \right)^2}{2f} \\ I_{L_{m,max}} &= I_{L_m} + \frac{\Delta I_{L_m}}{2} & L_m &= \frac{V_s DT}{\Delta I_{L_m}} = \frac{V_s D}{\Delta I_{L_m} f} \\ &= \frac{V_s D}{(1-D)^2 R} \left(\frac{N_2}{N_1} \right)^2 + \frac{V_s DT}{2L_m} & & & \\ I_{L_{m,min}} &= I_{L_m} - \frac{\Delta I_{L_m}}{2} & & & \text{equate this to zero for dcm boundary} \\ &= \frac{V_s D}{(1-D)^2 R} \left(\frac{N_2}{N_1} \right)^2 - \frac{V_s DT}{2L_m} & & & \\ \Delta V_{o,ESR} &= \Delta i_C r_C = I_{L_{m,max}} \left(\frac{N_1}{N_2} \right) r_C & & & \end{aligned}$$

Figure 3: Flyback Formulas

$$\begin{aligned} V_o &= V_s D \left(\frac{N_2}{N_1} \right) & \frac{\Delta V_o}{V_o} &= \frac{1-D}{8L_x C f^2} \end{aligned}$$

$$\Delta V_{o,ESR} = \Delta i_C r_C = \Delta i_{L_x} r_C = \left[\frac{V_o(1-D)}{L_x f} \right] r_C$$

$$\Delta i_{L_m} = \frac{V_s DT}{L_m}$$

Figure 4: Forward (single switched) Converter Formulas

$$SwitchUtilization = \frac{Po}{P_{sw}} = \frac{I_o V_o}{q V_{swmax} I_{swmax}} \quad (1)$$

$$\begin{aligned} V_o &= 2V_s \left(\frac{N_s}{N_p} \right) D & \frac{\Delta V_o}{V_o} &= \frac{1-D}{32L_x C f^2} \\ \Delta V_{o,ESR} &= \Delta i_{L_x} r_C = \left[\frac{V_o \left(\frac{1}{2} - D \right)}{L_x f} \right] r_C \end{aligned}$$

Figure 5: Push Pull Formulas

$$\begin{aligned} V_o &= V_s \left(\frac{D}{1-D} \right) & \Delta V_{C1} &= \frac{I_o DT}{C} = \frac{V_o D}{RC_1 f} \\ \Delta i_{L1} &= \frac{V_s DT}{L_1} = \frac{V_s D}{L_1 f} & \Delta V_o &= \Delta V_{C2} = \frac{V_o D}{RC_2 f} \\ \Delta i_{L2} &= \frac{V_s DT}{L_2} = \frac{V_s D}{L_2 f} & C_1 &= \frac{D}{R(\Delta V_{C1}/V_o)f} \\ & & C_2 &= \frac{D}{R(\Delta V_o/V_o)f} \end{aligned}$$

Figure 6: Sepic Converter Formulas

$$\begin{aligned} V_o &= -V_s \left(\frac{D}{1-D} \right) & \frac{\Delta V_o}{V_o} &= \frac{1-D}{8L_2 C_2 f^2} \\ \Delta v_{C1} &\approx \frac{1}{C_1} \int_0^T I_{L1} d(t) = \frac{I_{L1}}{C_1} (1-D)T = \frac{V_s}{RC_1 f} \left(\frac{D^2}{1-D} \right) \\ & & \Delta v_{C1} &\approx \frac{V_o D}{RC_1 f} \\ \Delta i_{L1} &= \frac{V_s DT}{L_1} = \frac{V_s D}{L_1 f} & \Delta i_{L2} &= \frac{V_s DT}{L_2} = \frac{V_s D}{L_2 f} \\ L_{1,min} &= \frac{(1-D)^2 R}{2Df} & L_{2,min} &= \frac{(1-D)R}{2f} \end{aligned}$$

Figure 7: Cuk Converter Formulas

$$\begin{aligned} V_o &= 2V_s \left(\frac{N_s}{N_p} \right) D & V_o &= V_s \left(\frac{N_s}{N_p} \right) D \\ \text{Full Bridge} & & \text{Half Bridge} & \end{aligned}$$

Figure 8: Full and Half Bridge Relations