Cheat Sheet for EE464

$$\text{Form Factor}=\frac{V_{rms}}{V_{avg}} \qquad \text{Crest Factor}=\frac{V_{peak}}{V_{rms}}$$

$$\text{Distortion Factor}=\frac{I_{1rms}}{I_{rms}}$$

ϕ : phase difference between fundamentals of current and voltage

$$\text{Displacement Power Factor}=\cos(\phi)$$

$$\text{True Power Factor}=\frac{P}{S}=\text{DPF}\frac{I_{1,RMS}}{I_{RMS}}$$

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

Magnetic Circuits

Flux Linkage $=\lambda=N\phi$	$\mathcal{F}=\Phi\mathcal{R}=NI$	$B=\mu H$
$B=\frac{\Phi}{A}$	$L=\frac{N\phi}{I}=N^2/\mathcal{R}$	$L=\frac{\lambda}{I}$
$NBA=\Phi N=\lambda$	$\mathcal{R}=\frac{l}{\mu A}$	$E=\frac{1}{2}\frac{B^2}{\mu}=\frac{1}{2}LI^2$
$\Delta Q=It$	$\Delta V=\frac{\Delta Q}{C}$	$\int Hdl=NI$

Converters

Flyback

$$\frac{V_o}{V_s}=\frac{D}{1-D}\frac{N_2}{N_1} \qquad \frac{\Delta V_o}{V_o}=\frac{D}{RCf} \qquad L_{m,min}=\frac{(1-D)^2R}{2f}(\frac{N_1}{N_2})^2$$

$$I_C=I_{L_M}\frac{N_1}{N_2}-\frac{V_o}{R} \qquad L_m=\frac{V_sDT}{\Delta i_{L_m}} \qquad \Delta V_o=\Delta i_c r_c=I_{L_{m,max}}\frac{N_1}{N_2}r_c$$

$$\hat{V}_{sw}=V_s+\frac{N_1}{N_2}V_o=\frac{V_s}{(1-D)} \qquad I_{L_m}=\frac{V_sD}{(1-D)^2R}\frac{N_2}{N_1}^2\pm\frac{V_sDT}{2L_m}$$

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

Forward

$$\frac{V_o}{V_s}=\frac{N_2}{N_1}D \qquad \frac{\Delta V_o}{V_o}=\frac{1-D}{8L_xCf^2} \qquad D\left(1+\frac{N_3}{N_1}\right)<1$$

$$\Delta I_{L_M}=\frac{V_sDT}{Lm} \qquad L_x=\frac{V_o}{R} \qquad \Delta I_{L_x}=\frac{V_o(1-D)}{L_xf}$$

$$\Delta V_o=\Delta i_c r_c=\Delta i_{L_x}r_c=r_c\frac{V_o(1-D)}{L_xf}$$

Push-Pull

$$\frac{V_o}{V_s}=2\frac{N_2}{N_1}D \qquad \frac{\Delta V_o}{V_o}=\frac{1-2D}{32L_xCf^2} \qquad I_{L_x}=\frac{V_o}{R}$$

$$\Delta V_o=\Delta i_{L_x}r_c=r_c\frac{V_o(\frac{1}{2}-D)}{L_xf}$$

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$$\frac{V_o}{V_s}=\frac{D}{1-D} \qquad \frac{\Delta V_o}{V_o}=\frac{1-D}{8L_2C_2f^2} \qquad \Delta V_{C_1}\approx\frac{V_oD}{RC_1f}$$

$$\Delta I_{L_1}=\frac{V_sDT}{L_1} \qquad \Delta I_{L_2}=\frac{V_sDT}{L_2}$$

$$L_{1,min}=\frac{(1-D)^2R}{2Df} \qquad L_{2,min}=\frac{(1-D)R}{2f}$$

$$\Delta V_{C_1}\approx\frac{1}{C_1}\int_{DT}^{T}I_{L_1}dt=\frac{I_{L_1}}{C_1}(1-D)T=\frac{V_s}{RC_1f}\frac{D^2}{1-D}$$

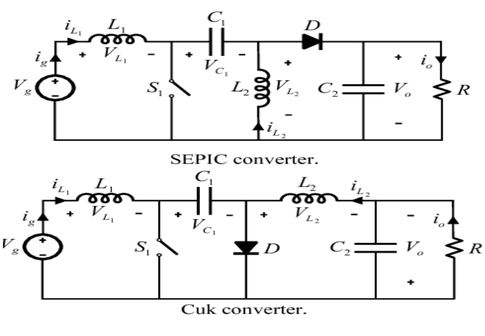

Figure 1: Sepic and Cuk Converter Schematics

Topology	V_{sw}	I_{sw}	$V_{01,max}$	q
Push Pull	$2V_{d,max}$	$\sqrt{2}\frac{I_{o,max}}{n}$	$\frac{4}{\pi\sqrt{2}}\frac{V_{d,max}}{n}$	2
Half B.	$V_{d,max}$	$\sqrt{2}I_{o,max}$	$\frac{4}{\pi\sqrt{2}}\frac{V_{d,max}}{2}$	2
Full B.	$V_{d,max}$	$\sqrt{2}I_{o,max}$	$\frac{4}{\pi\sqrt{2}}V_{d,max}$	4

Table 1: Swith Utilization doesnt change$(1/2\pi)$ for n:1 trans. ratio and in linear region scaled by $(m_a\pi)/4$

$$\boxed{V_o=V_s\left(\frac{D}{1-D}\right)} \qquad \Delta V_{C_1}=\frac{I_oDT}{C}=\frac{V_oD}{RC_1f}$$

$$\Delta i_{L_1}=\frac{V_sDT}{L_1}=\frac{V_sD}{L_1f} \qquad \boxed{\Delta V_o=\Delta V_{C2}=\frac{V_oD}{RC_2f}}$$

$$\Delta i_{L_2}=\frac{V_sDT}{L_2}=\frac{V_sD}{L_2f} \qquad \boxed{C_1=\frac{D}{R(\Delta V_{C_1}/V_o)f}}$$

$$I_{L_1}=I_s=\frac{V_oI_o}{V_s}=\frac{V_o^2}{V_sR} \qquad \boxed{C_2=\frac{D}{R(\Delta V_o/V_o)f}}$$

$$I_{L_2}=I_o$$

Figure 2: Sepic Converter Formulas

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 3: Flyback switch considerations

$$\boxed{V_o=2V_s\left(\frac{N_S}{V_P}\right)D} \qquad \boxed{V_o=V_s\left(\frac{N_S}{N_P}\right)D}$$

Full Bridge **Half Bridge**

Figure 4: Full and Half Bridge Relations

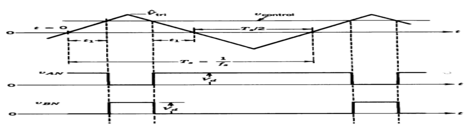

Figure 5: Bipolar Switching

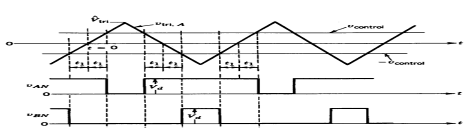

Figure 6: Unipolar switching