Cheat Sheet for EE464

Performance Parameters

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

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

Symmetry	Condition Required	a_h and b_h
Even	$f(-t) = f(t)$	$b_h = 0 \quad a_h = \frac{2}{\pi}\int_0^{\pi} f(t)\cos(h\omega t)\, d(\omega t)$
Odd	$f(-t) = -f(t)$	$a_h = 0 \quad b_h = \frac{2}{\pi}\int_0^{\pi} f(t)\sin(h\omega t)\, d(\omega t)$
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

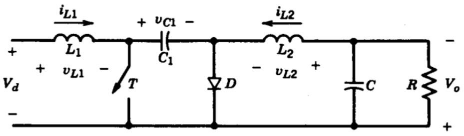


Figure 2: Cuk converter

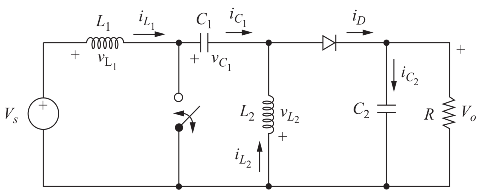


Figure 3: Sepic converter

Switch Selection

Peak Switch Current

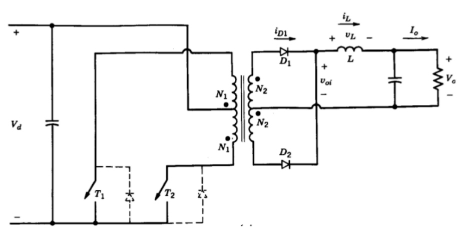
$$\hat{I}_{sw} = \frac{1}{(1-D)}\frac{N_2}{N_1}I_o + \frac{N_1}{N_2}\frac{(1-D)T_s}{2L_m}V_o$$

Peak Switch Voltage

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

Figure 4: Flyback switch considerations

Push-Pull Converter



Fourier Coefficients

$$SwitchUtilization = \frac{Po}{Psw} = \frac{Io.Vo}{Vswmax.Iswmax} \qquad (1)$$

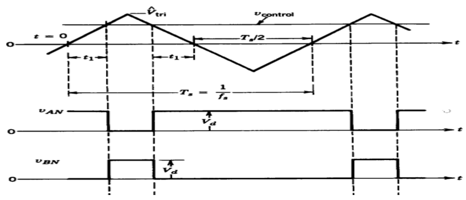


Figure 5: Bipolar Switching

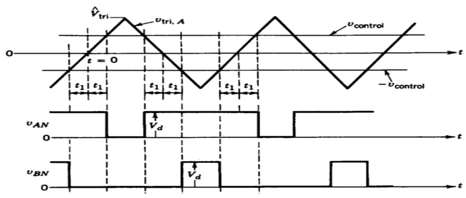


Figure 6: Unipolar switching

Table 8-1 Generalized Harmonics of v_{Ao} for a Large m_f.

h \ m_a	0.2	0.4	0.6	0.8	1.0
1 Fundamental	0.2	0.4	0.6	0.8	1.0
m_f	1.242	1.15	1.006	0.818	0.601
$m_f \pm 2$	0.016	0.061	0.131	0.220	0.318
$m_f \pm 4$					0.018
$2m_f \pm 1$	0.190	0.326	0.370	0.314	0.181
$2m_f \pm 3$		0.024	0.071	0.139	0.212
$2m_f \pm 5$				0.013	0.033
$3m_f$	0.335	0.123	0.083	0.171	0.113
$3m_f \pm 2$	0.044	0.139	0.203	0.176	0.062
$3m_f \pm 4$		0.012	0.047	0.104	0.157
$3m_f \pm 6$				0.016	0.044
$4m_f \pm 1$	0.163	0.157	0.008	0.105	0.068
$4m_f \pm 3$	0.012	0.070	0.132	0.115	0.009
$4m_f \pm 5$			0.034	0.084	0.119
$4m_f \pm 7$				0.017	0.050

Note: $(\hat{V}_{Ao})_h/\frac{1}{2}V_d$ [$= (\hat{V}_{AN})_h/\frac{1}{2}V_d$] is tabulated as a function of m_a.

Figure 7: Harmonics

Table 8-5 Normalized Fourier Coefficients V_n/V_{dc} for Unipolar PWM in Fig. 8-18

	m_a=1	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1
n=1	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20	0.10
n=2m_f±1	0.18	0.25	0.31	0.35	0.37	0.36	0.33	0.27	0.19	0.10
n=2m_f±3	0.21	0.18	0.14	0.10	0.07	0.04	0.02	0.01	0.00	0.00

Figure 8: Unipolar Harmonics

Table 8-3 Normalized Fourier Coefficients V_n/V_{dc} for Bipolar PWM

	m_a=1	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1
n=1	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20	0.10
n=m_f	0.60	0.71	0.82	0.92	1.01	1.08	1.15	1.20	1.24	1.27
n=mf±2	0.32	0.27	0.22	0.17	0.13	0.09	0.06	0.03	0.02	0.00

Figure 9: Bipolar Harmonics

$$\boxed{V_o = V_s\left(\frac{D}{1-D}\right)\left(\frac{N_2}{N_1}\right)} \qquad \boxed{\frac{\Delta V_o}{V_o} = \frac{D}{RCf}}$$

$$I_{L_{m,\max}} = I_{L_m} + \frac{\Delta i_{L_m}}{2}$$

$$= \frac{V_s D}{(1-D)^2 R}\left(\frac{N_2}{N_1}\right)^2 + \frac{V_s DT}{2L_m}$$

$$I_{L_{m,\min}} = I_{L_m} - \frac{\Delta i_{L_m}}{2}$$

equate this to zero for dcm boundary

$$= \frac{V_s D}{(1-D)^2 R}\left(\frac{N_2}{N_1}\right)^2 - \frac{V_s DT}{2L_m}$$

$$\Delta V_{o,\mathrm{ESR}} = \Delta i_C r_C = I_{L_{m,\max}}\left(\frac{N_1}{N_2}\right) r_C$$

Figure 10: Flyback Formulas

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

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

$$\Delta i_{L_m} = \frac{V_s D T}{L_m}$$

Figure 11: Forward (single switched) Converter Formulas

$$\boxed{V_o = 2 V_s\left(\frac{N_S}{N_P}\right) D} \quad \boxed{\frac{\Delta V_o}{V_o} = \frac{1 - 2D}{32 L_x C f^2}}$$

$$\Delta V_{o,ESR} = \Delta i_{L_x} r_C = \left[\frac{V_o\left(\frac{1}{2} - D\right)}{L_x f}\right] r_C$$

Figure 12: Push Pull Formulas