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Engineering Note

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Project: Solenoid Energization, Controls, Interlocks & Quench Protection
Doc. No: H960730A

Subject: Power Supply Ripple Calculation

The 12 phase power supply has its rectified phases on 30 degree spacing. The worst case ripple should be when the firing angle is 150 degrees. At this firing point, each phase is returning to the 180 degree zero crossing at a very steep slope and it will reach zero before the next phase is conducted through its SCR. The following spreadsheet shows the calculation of rms ripple voltage resulting from this worst case firing angle of 150 degrees. One period of ripple voltage extends from 150 to 180 degrees of one phase. The initial peak value of 15.75V was chosen as the value needed to produce 15.5Vrms maximum from an uncontrolled, unfiltered 12 phase power supply. As shown, the peak to peak amplitude of the ripple is 7.88 volts. The rms value of this ripple is found by numerical analysis i.e. dividing the waveform into 5 degree slices, squaring the voltage at each slice, summing and averaging each squared voltage to find the mean of the squares; and finally calculating the square root of the resulting mean of the squares. As the spreadsheet shows, the 720 Hz ripple should have a worst case value of 4.67 Vrms.

	A	B	C	D	E	F	G	H
1	Peak Volts	Angle	Time	Voltage	V^2		Ripple pk	Ripple pk^2
2	15.75	150	0.006944	7.88	62.02		0.00	0.00
3		155	0.007176	6.66	44.31		1.22	1.49
4		160	0.007407	5.39	29.02		2.49	6.19
5		165	0.007639	4.08	16.62		3.80	14.43
6		170	0.00787	2.73	7.48		5.14	26.42
7		175	0.008102	1.37	1.88		6.50	42.28
8		180	0.008333	0.00	0.00		7.88	62.02
9								
10				Sum (DC)	161.32		Sum (Ripple)	152.82
11								
12				Average (DC)	23.05		Average (Ripple)	21.83
13								
14				RMS (DC)	4.80		RMS (Ripple)	4.67
15								
16				Ripple P-P	7.88			
17								
18								
19	Time = (1/60)*(1/360)*Angle							
20	Voltage = Vp*SIN(2*PI*60*Time)							
21	V^2 = Voltage * Voltage							
22	Sum = SUM of all V^2							
23	Average = SUM/7							
24	RMS = SQRT(Average)							
25	Ripple P-P= Vmax - Vmin							