MIDDLE EAST TECHNICAL UNIVERSITY

ELECTRICAL ELECTRONICS ENGINEERING

EE493 STATIC POWER CONVERSION-I

PROJECT#1 REPORT

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I. INTRODUCTION

In power electronics applications, AC voltage is firstly converted into DC. This conversion is done by using circuit topologies which are called rectifiers in general. In this project, we have been asked to work with rectifiers built using diodes. Diode rectifiers are inexpensive when compared to other rectifiers built using different components such as thyristors. One of the reasons this is true is that it is not possible to adjust the DC output voltage of diode rectifiers. That is why they are called uncontrolled rectifiers. However, not all applications require adjustable DC voltage. Therefore, diode rectifiers are still widely used. Throughout the simulations it is assumed that the circuits are connected to Turkish grid.

II. RESULTS

A. Part 1

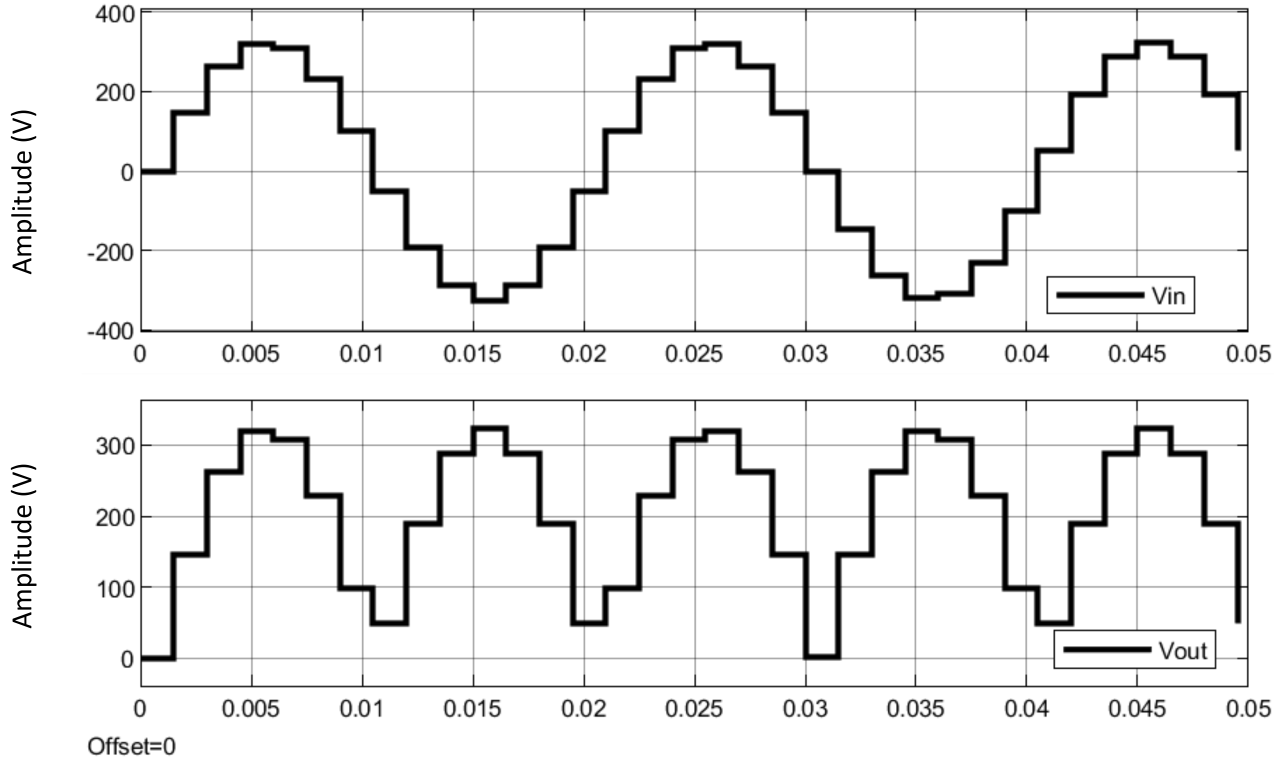


Figure 1: Simulation results of the single-phase diode rectifier given in question 1, where the step size is set to 1.5 msec

Step size is the period at which the solver will run. Therefore, it affects the final results of the simulation in terms of speed and accuracy. Evidently, the shorter the step size is the more accurate the simulation results will be. However, as this means calculating more values for the given simulation period, lowering the step size lengthens the time required for the simulation. Thus, it is a trade-off between speed and accuracy. For example, in this question 1.5 msec was too long. The distortion in the simulation can be seen as a stair waveform, indicated by Figure 1. However, 10 µsec and 1 µsec step sizes are acceptable since the outputs of the simulations are accurate enough which can be seen in Figures 2 and 3, respectively.

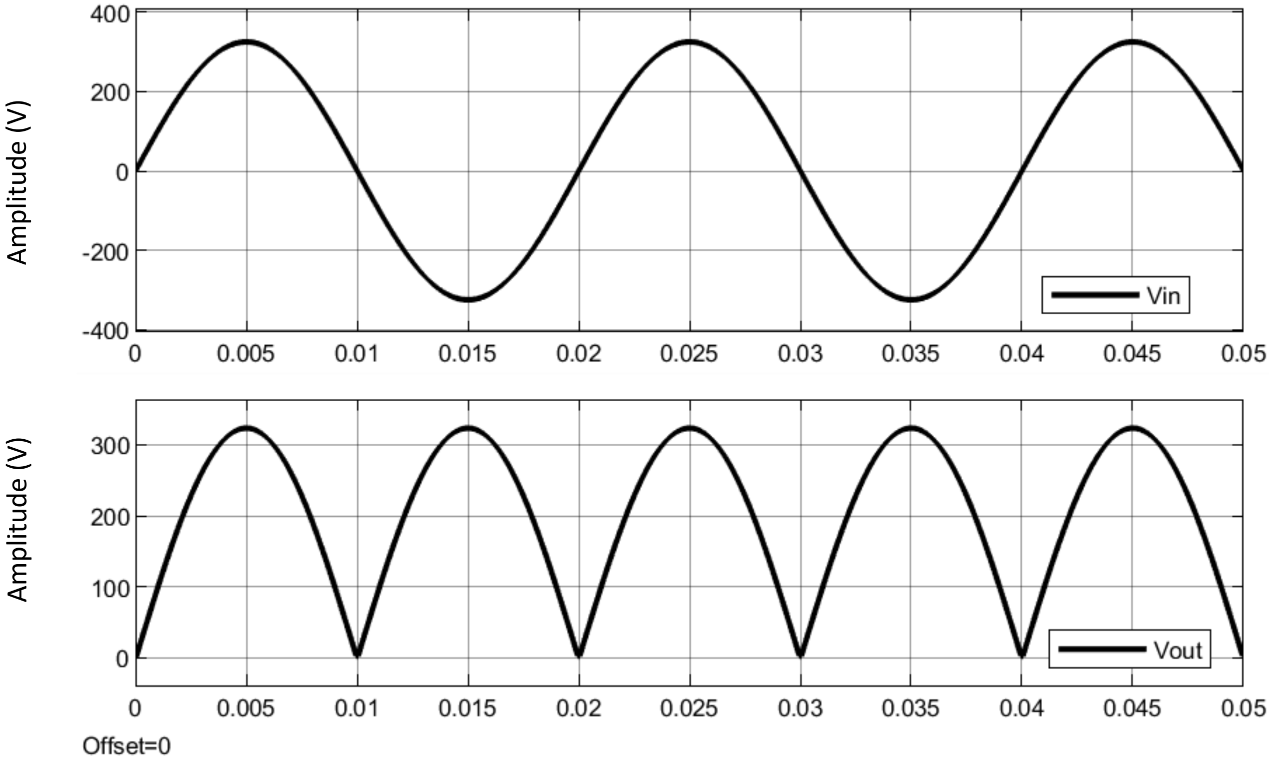


Figure 2: Simulation results of the single-phase diode rectifier given in question 1, where the step size is set to 10 µsec

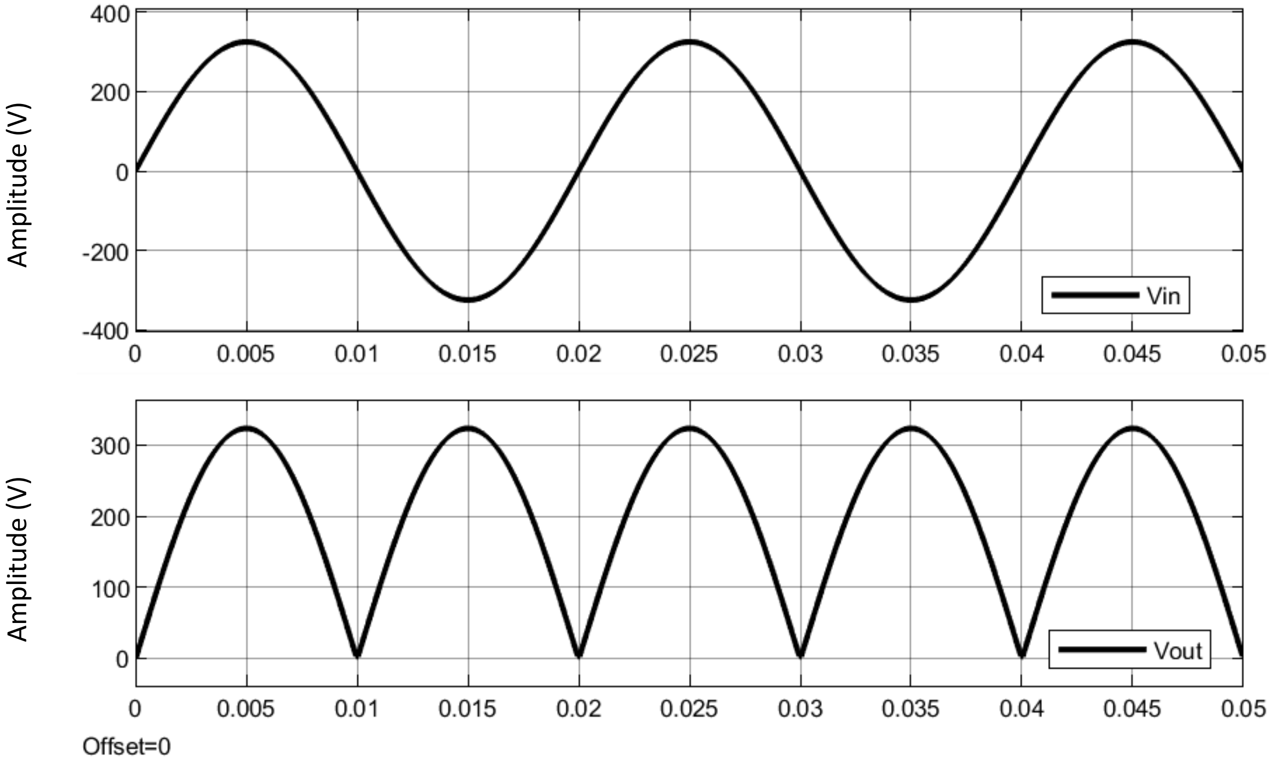


Figure 3: Simulation results of the single-phase diode rectifier given in question 1, where the step size is set to 1 µsec

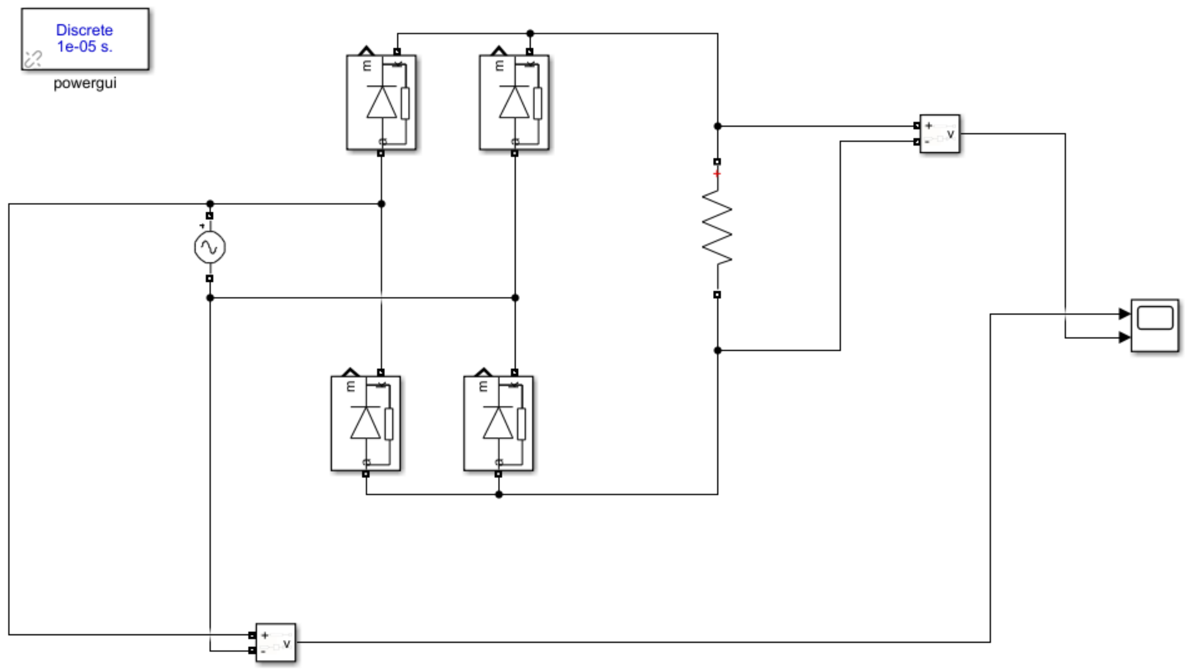


Figure 4: The circuit diagram which was used to obtain the simulation results given in Figures 1, 2 and 3

B. Part 2.1

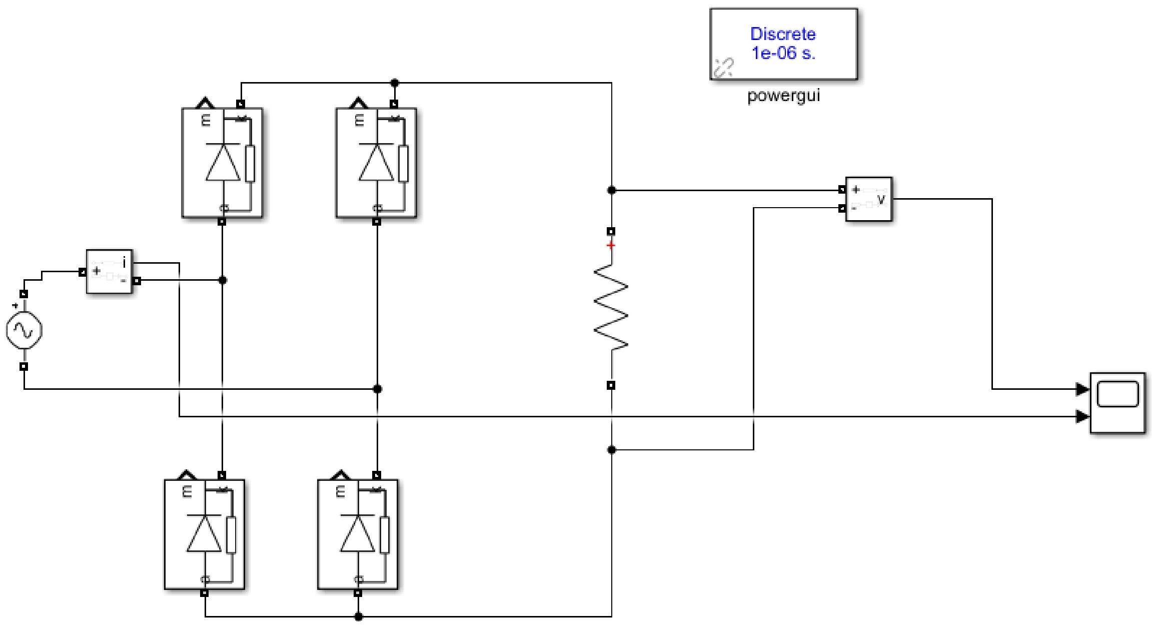


Figure 5: Circuit diagram of part 2.1 for resistive load of R = 25 Ω

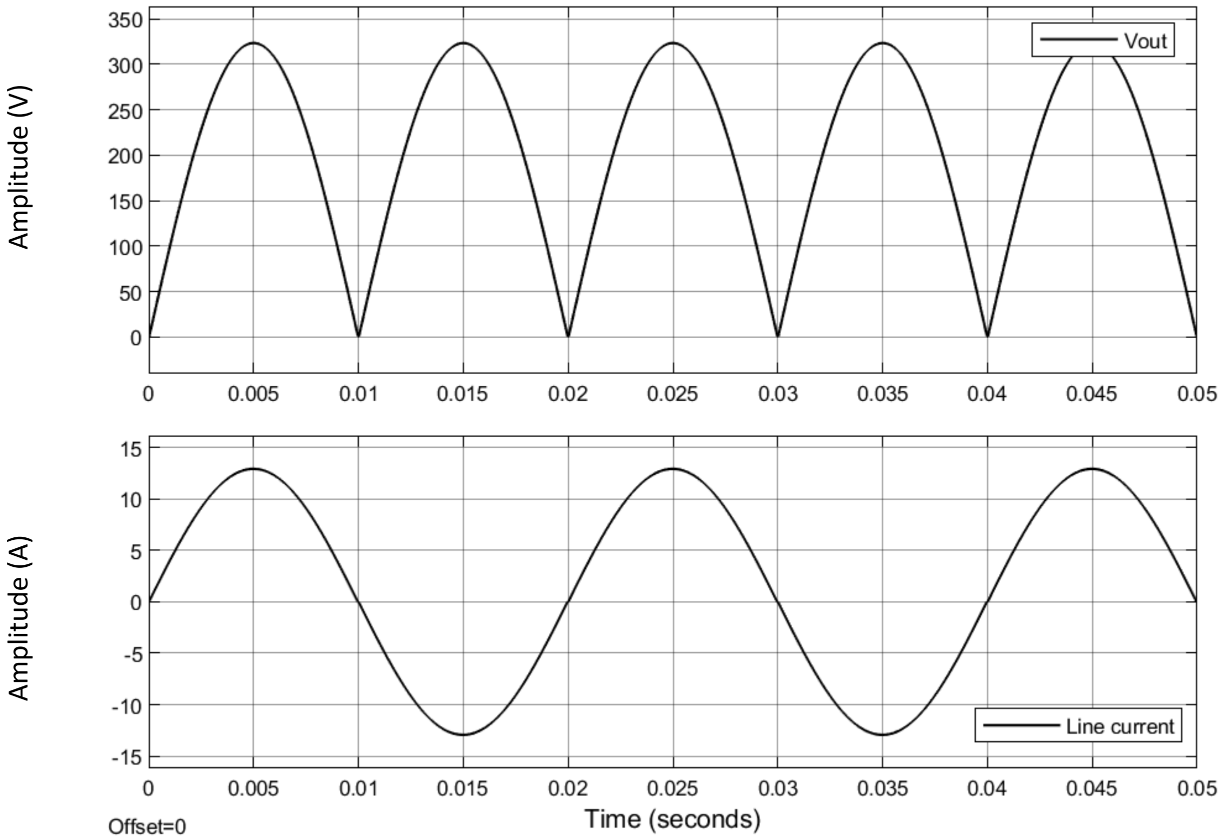


Figure 6: Output voltage and line current waveform for the circuit given in Figure 5, average output voltage=205.3 V

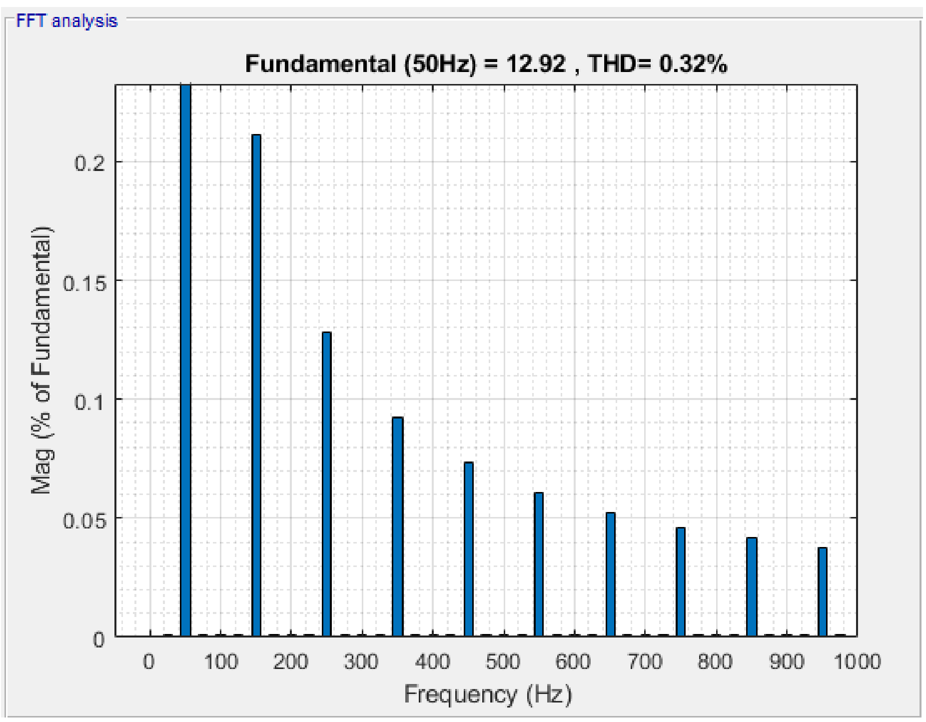


Figure 7: FFT analysis of the line current shown in Figure 6, THD=0.32%

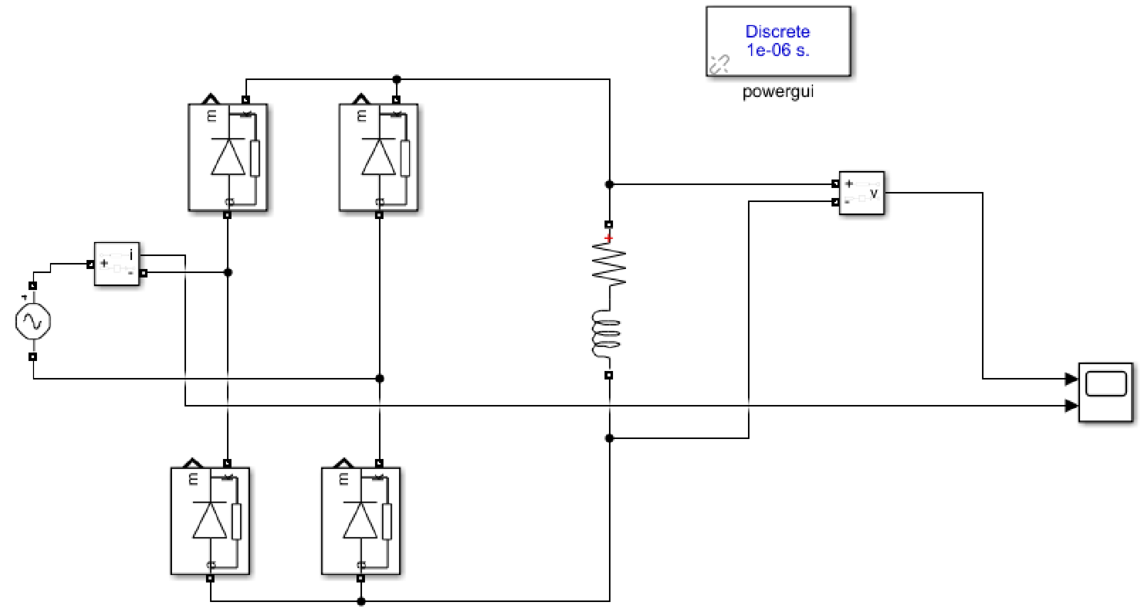


Figure 8: Circuit diagram of part 2.1 for RL load of R = 25 Ω, L = 10 mH

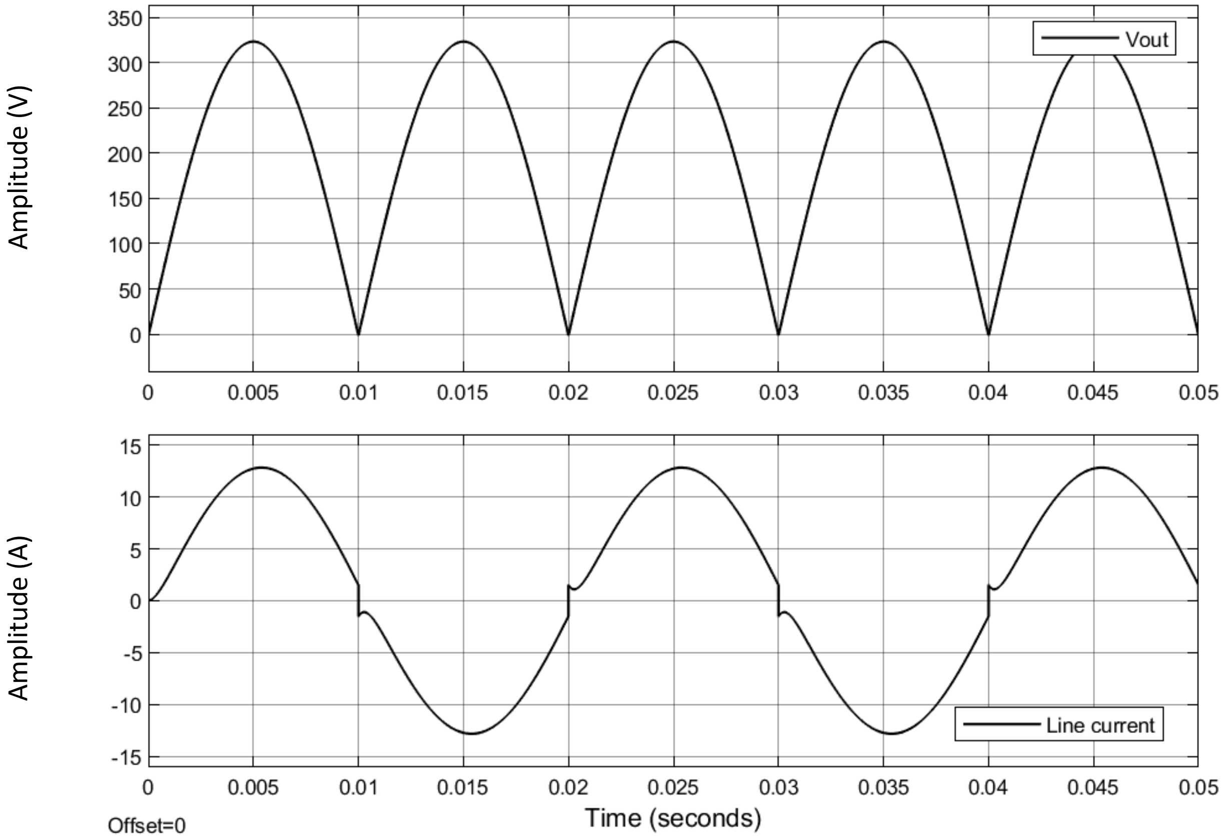


Figure 9: Output voltage and line current waveform for the circuit given in Figure 8, average output voltage=205.3 V

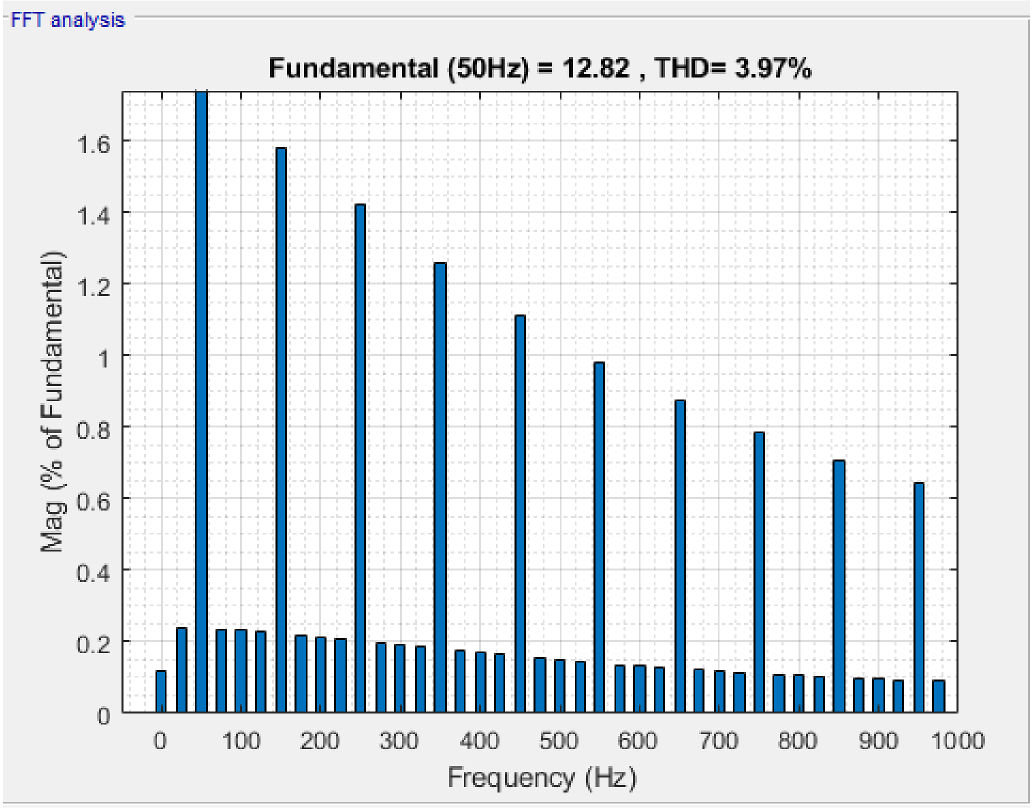


Figure 10: FFT analysis of the line current shown in Figure 9, THD=3.97%

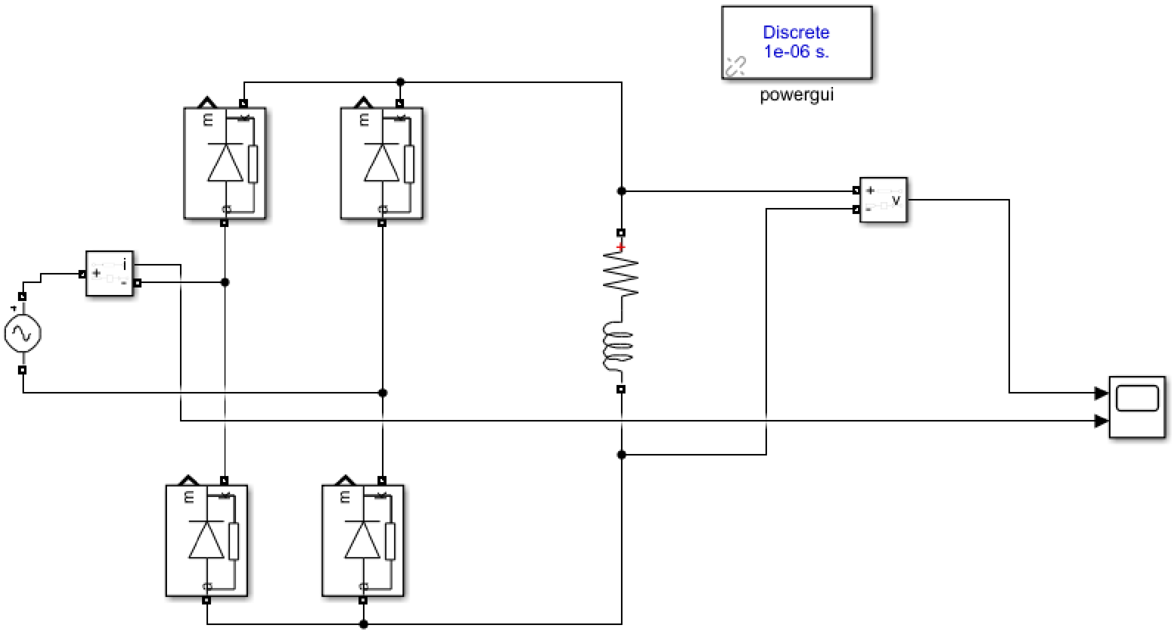


Figure 11: Circuit diagram of part 2.1 for RL load of R = 25 Ω, L = 1 H

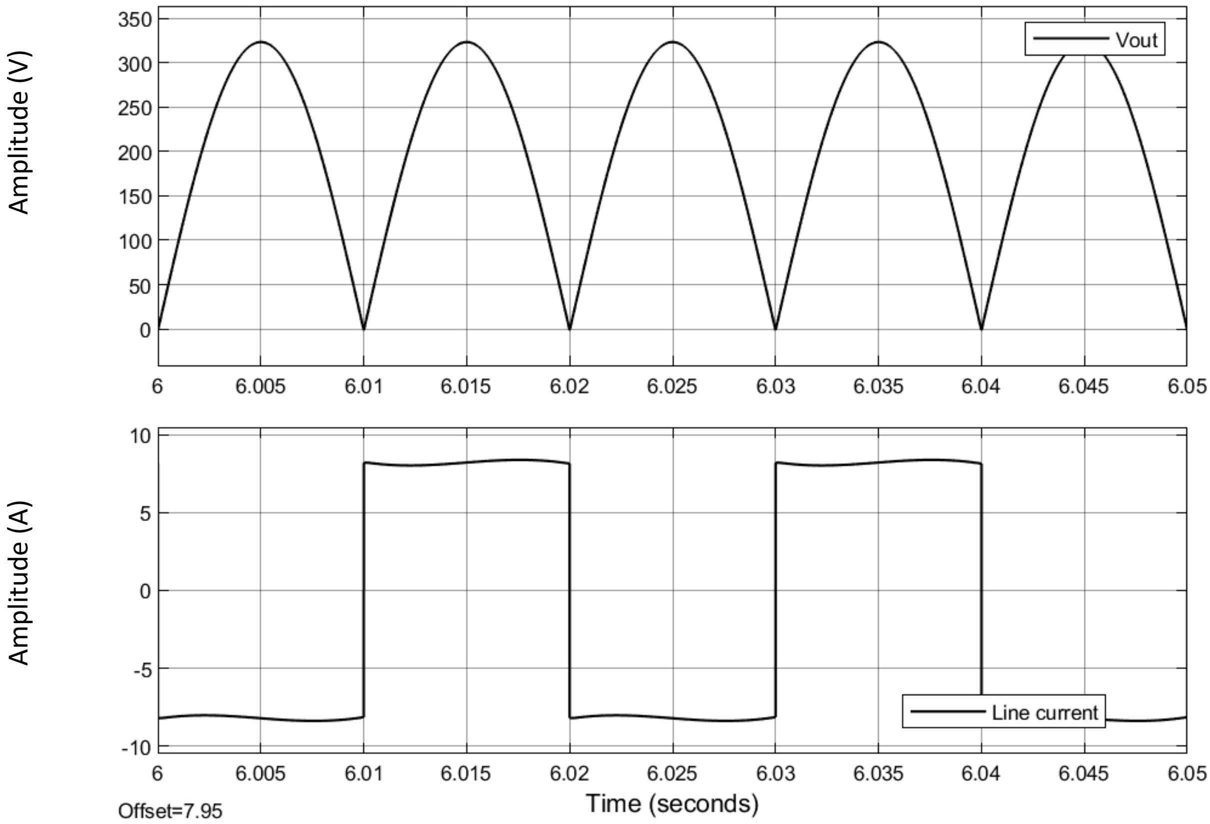


Figure 12: Output voltage and line current waveform for the circuit given in Figure 11, average output voltage=205.3 V

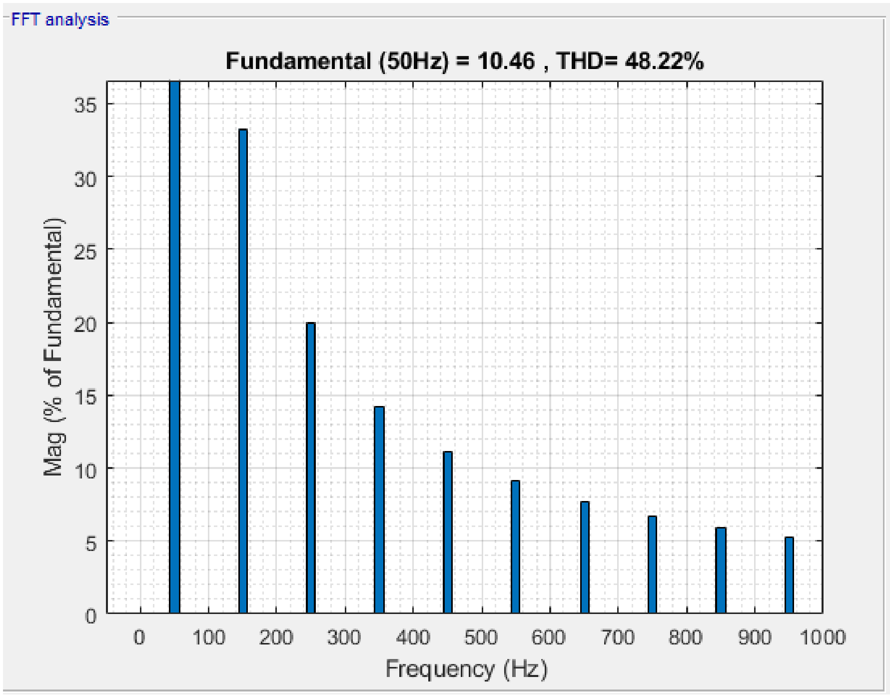


Figure 13: FFT analysis of the line current shown in Figure 12, THD=48.22%

As load inductance increases line current starts to turn into a square wave. At infinite load inductance, load behaves like ideal current source which draws a pure square wave from the grid.

B. Part 2.2

During simulations it is observed that the current through the diodes is around 13 A. While searching through DigiKey, we have decided to set a rating of 1.5 times of the maximum current for safety which turns out to be 20 A. Also, the maximum voltage is around 325 V. However again we have set a minimum limit of 400 V. With these restrictions, we have searched through the product that are in stock. Finally, we have decided that, for a rectifier module we would go with DFB2040-ND whereas for discrete diodes FFPF20UP40S-ND is our choice. Also, it should be noted that while deciding we also considered the minimum order amount since some products required minimum quantity as hundreds to thousands. Evidently, we do not need as much. One of the biggest differences between these two choices is heat dissipation. Single diodes are easier to cool since each one of them has more empty space surrounding it. Additionally, discrete components allow more versatility while designing the PCB.

B. Part 2.3

Throughout the simulations it is decided that the required capacitance value is greater than 0.4 mF. At 0.4 mF the ripple with respect to the average of the output turns out to be as 19.7%. As the capacitance value is increased the percentage ripple will decrease. We picked the rated voltage as 385 V. The choice for the value of the capacitance is 470 µF which is a common value in this interval. The cheapest one with these requirements on DigiKey is SLPX471M385E9P3-ND . The percentage ripple value is calculated by the means of equation (1), given below.

$$Ripple\% = \frac{V_{max} - V_{min}}{V_{mean}} \times 100 \tag{1}$$

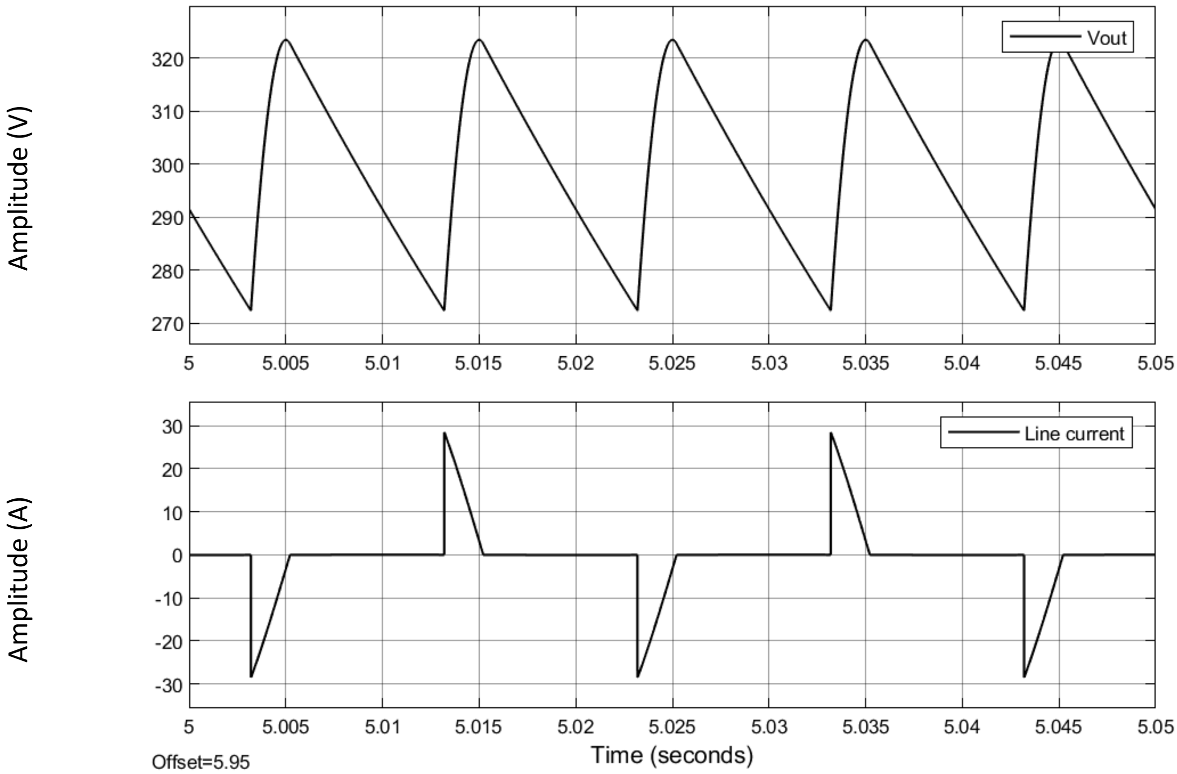


Figure 14: 17% ripple with respect to average value of output voltage

B. Part 2.4

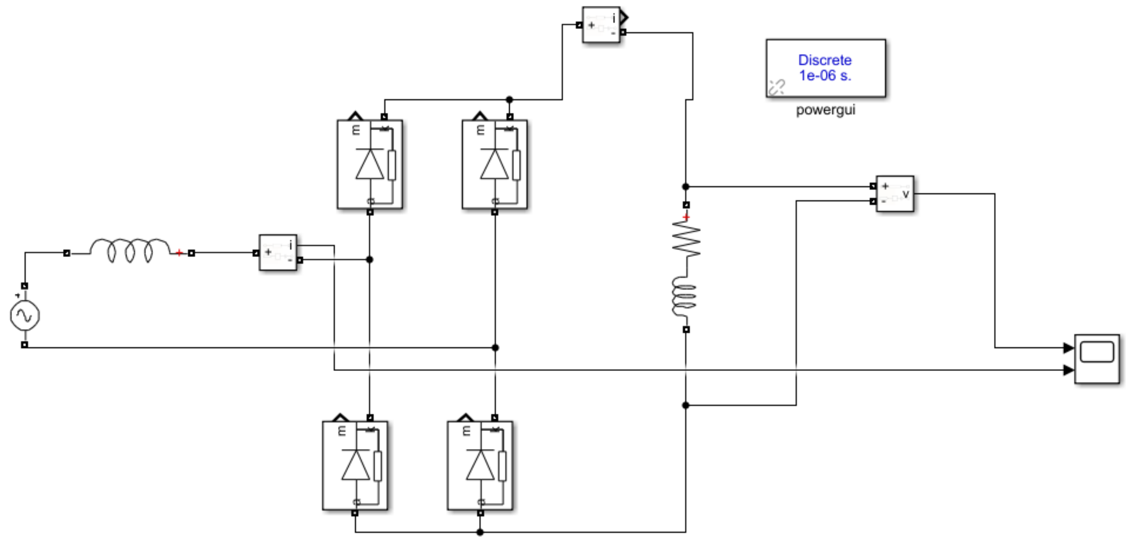


Figure 15: Circuit diagram of part 2.4

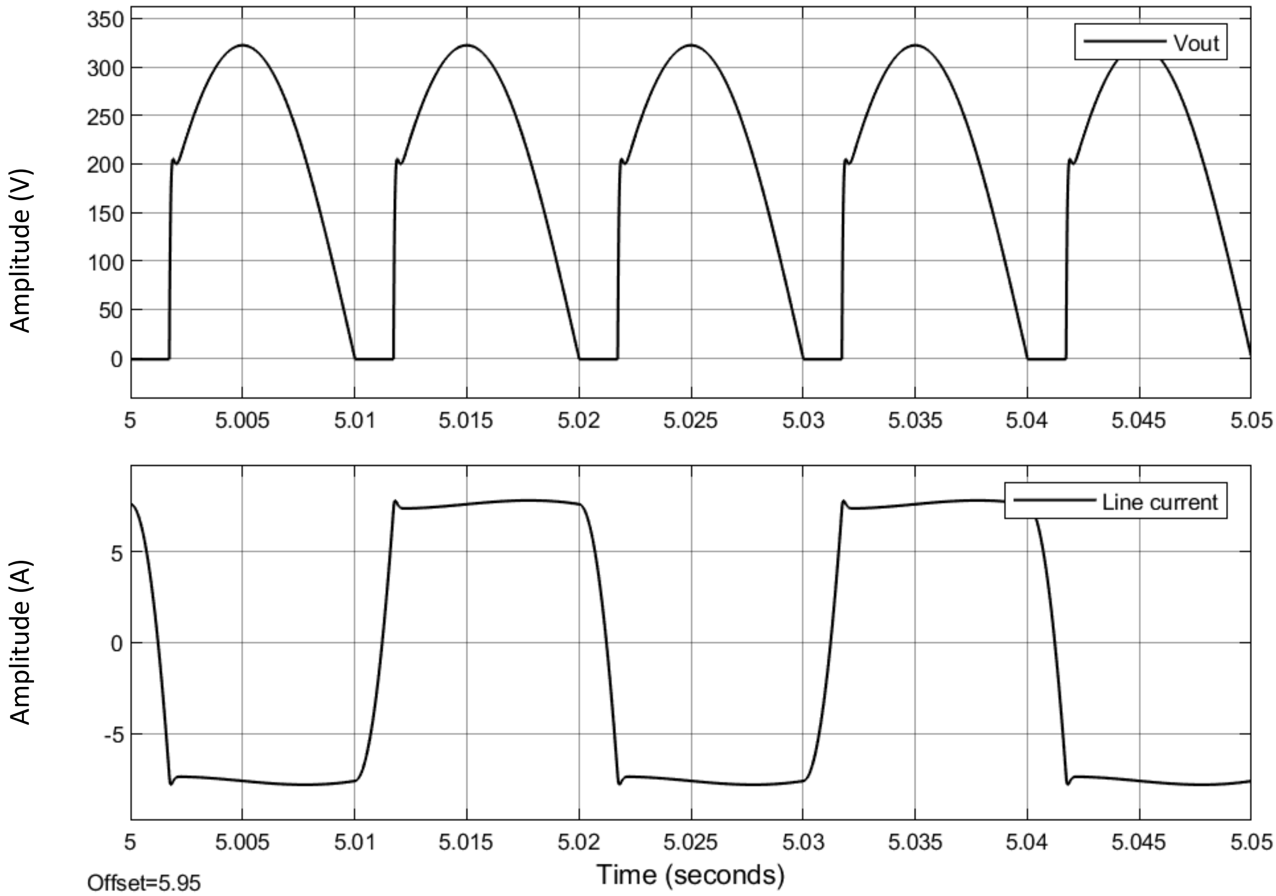


Figure 16: Output voltage and line current waveform for the circuit given in Figure 15, average output voltage=190 V

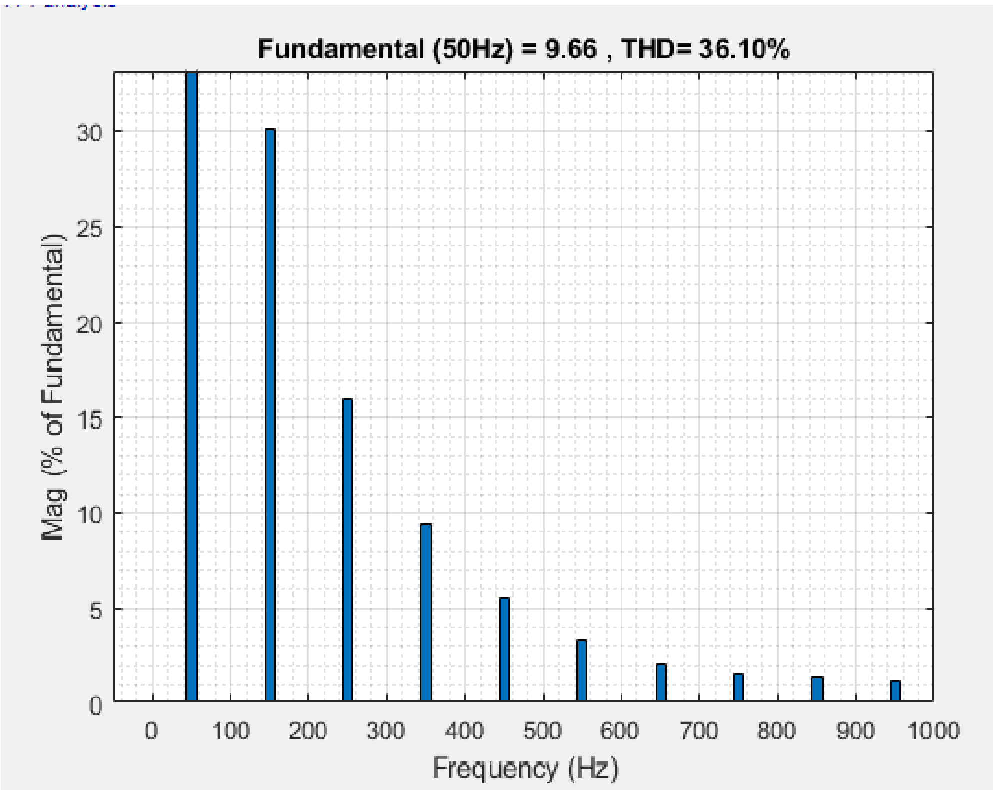


Figure 17: FFT analysis of the line current shown in Figure 16, THD=36.10%

Without the line inductance we have observed that the line current becomes a square wave as indicated in Figure 12. This means that it changes instantaneously with a discontinuity of 90-degree slope. When the line inductance is introduced, this cannot occur since the voltage across an inductor is proportional to the rate of change of the current through it. If the current is discontinuous this would mean infinite voltage which makes no sense in this context. Therefore, something else happens. After input voltage turns negative, a positive current will still flow through the circuit due to the inductor. This leads into what is called commutation. Because of this output voltage gets deformed as indicated in Figure 16. This causes the average value of the output voltage to decrease.

B. Part 2.5

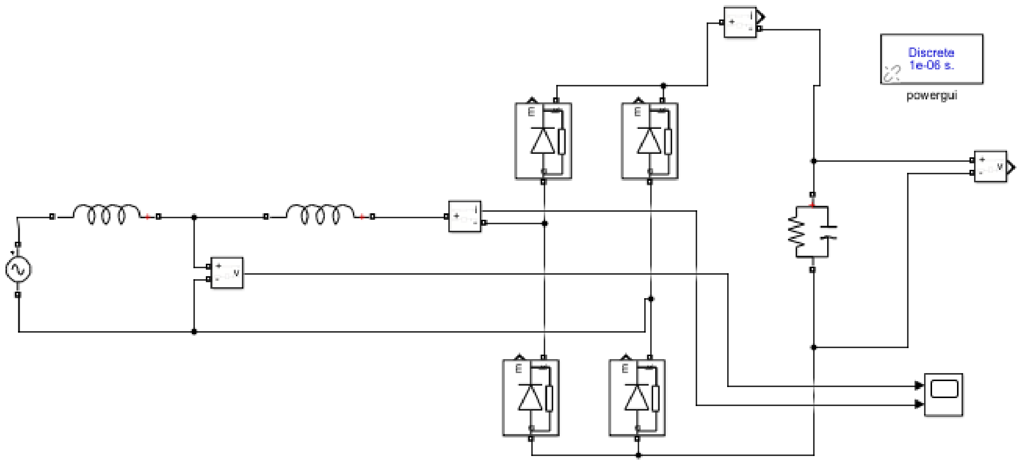


Figure 18: Circuit diagram of part 2.5

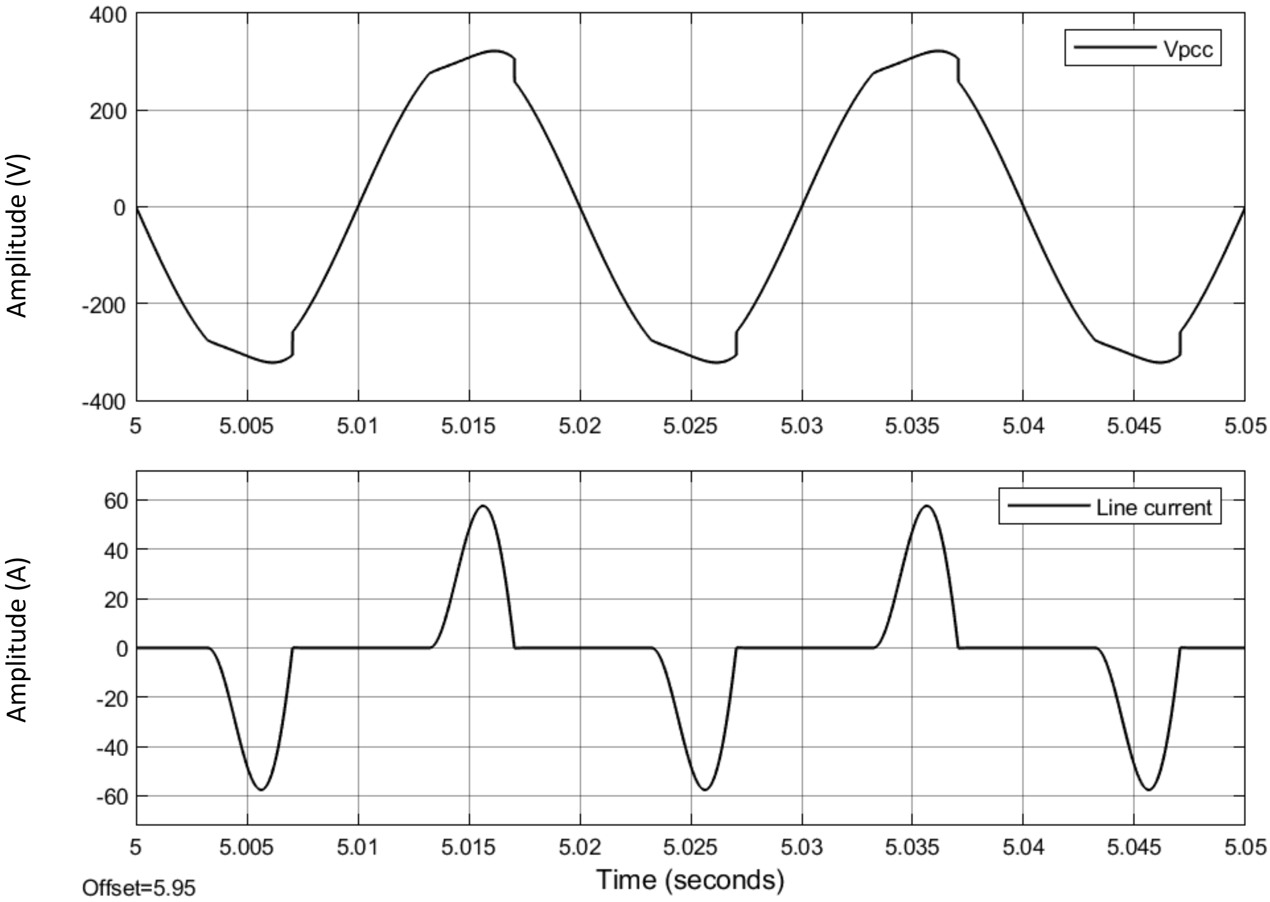


Figure 19: Common coupling voltage and line current waveform for the circuit given in Figure 18, distorted currents drawn from the utility grid (below) can affect and distort the input voltage (above)

C. Part 3.1/2:

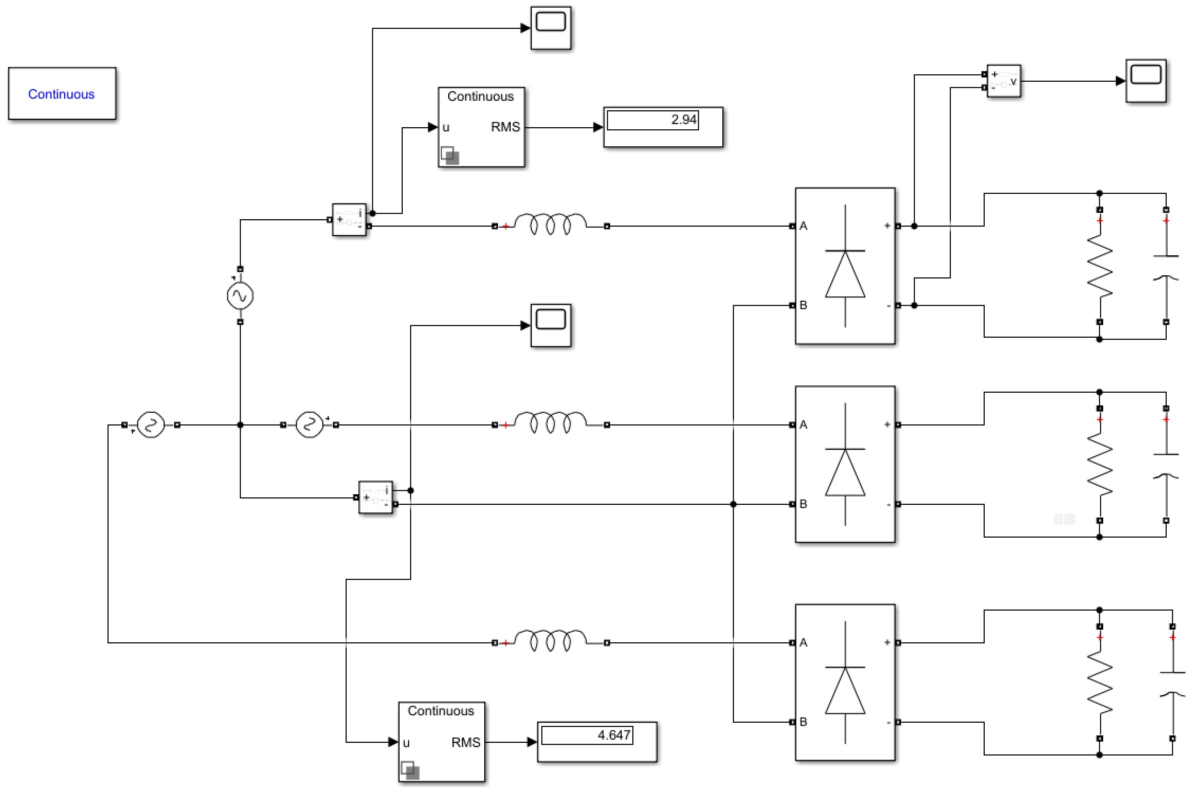


Figure 20: The whole schematic of single-phase diode rectifiers operated from a three-phase grid with neutral connection

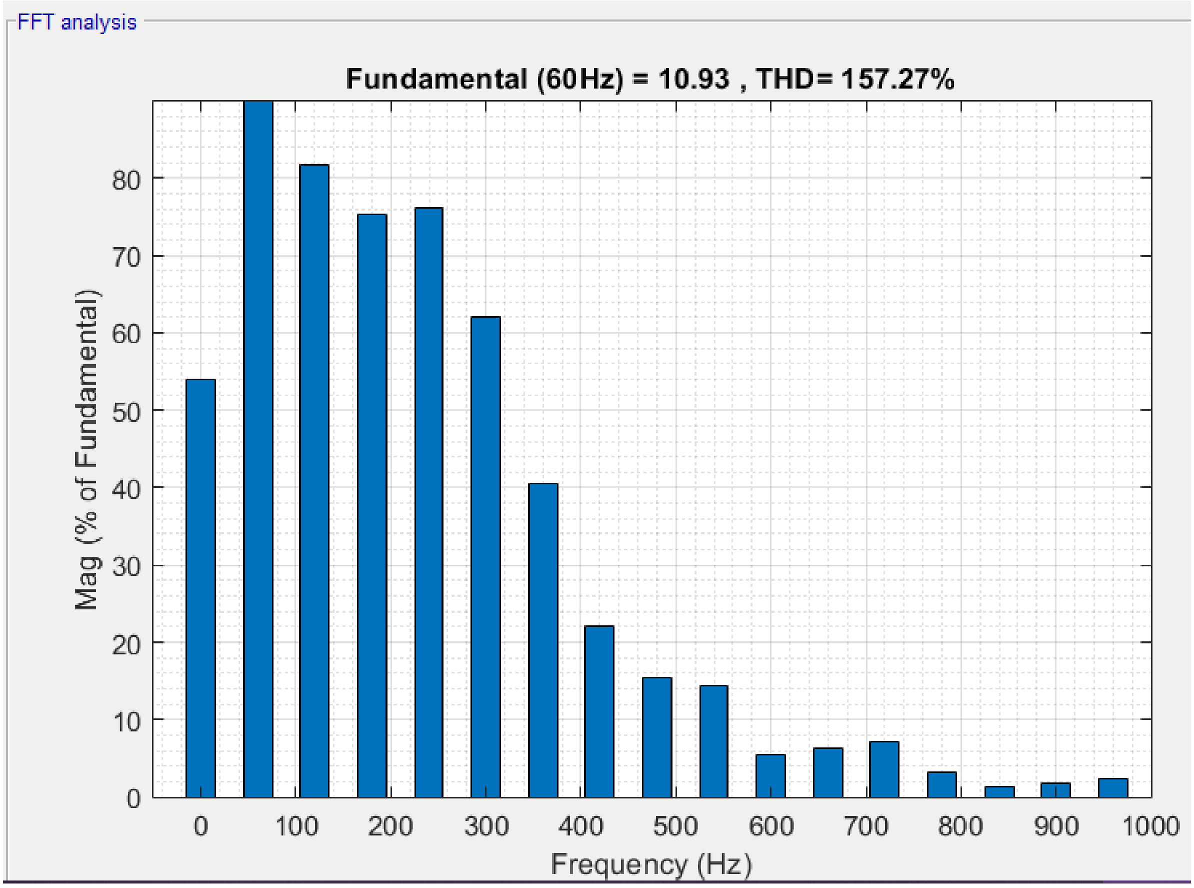


Figure 21: THD distribution of input current

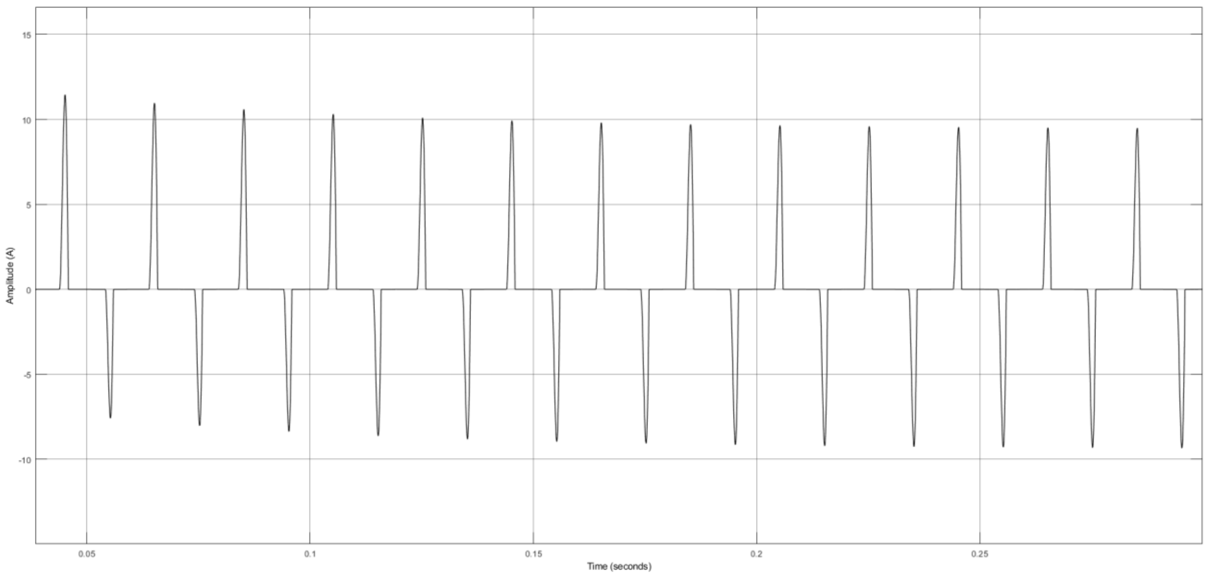


Figure 22: Phase A current characteristic

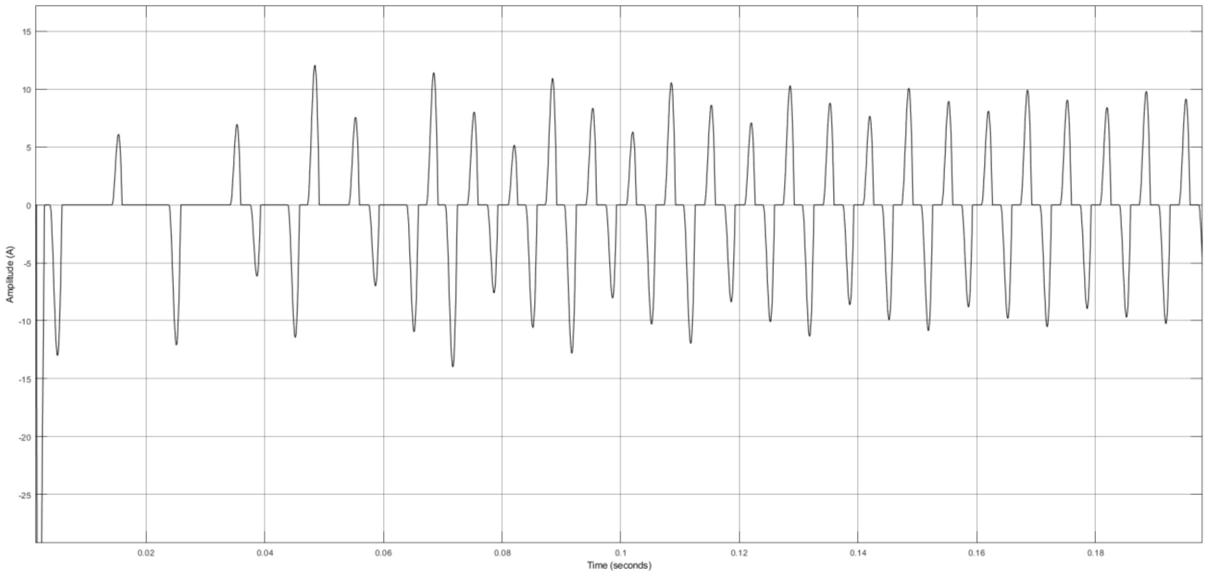


Figure 23: Neutral wire current characteristic

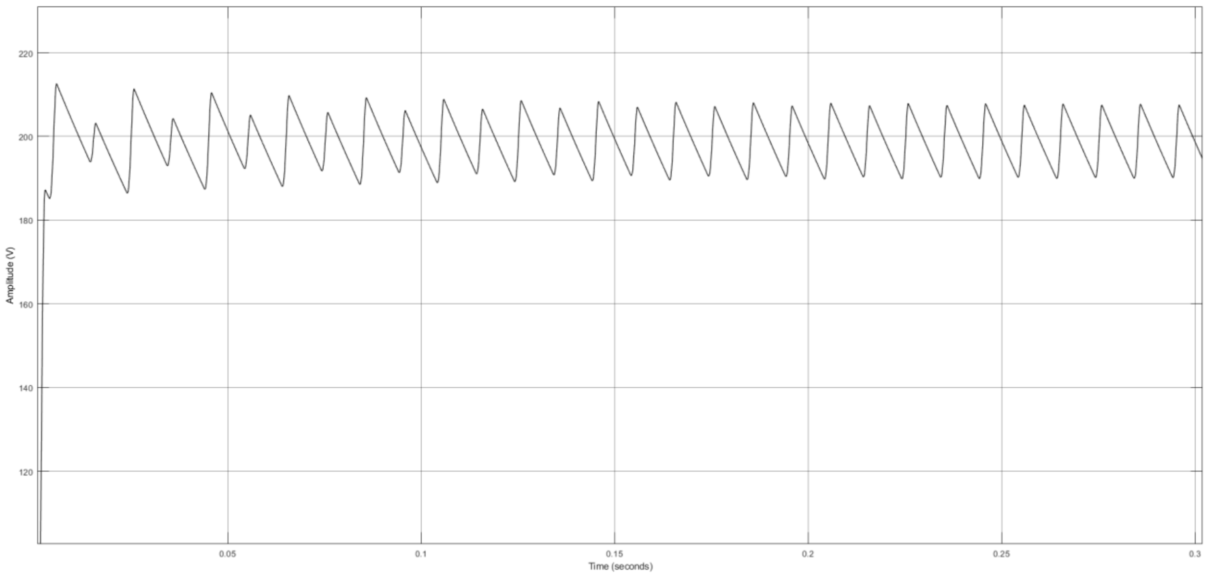


Figure 24: Output voltage characteristic of diode bridge 1

As seen in the display component, Figure 20:

- RMS value of line current = 2.94 A
- RMS value of neutral line = 4.647 A
  The neutral line current RMS value is higher than phase current because according to basic circuit principle, currents going in must be balanced going out currents. According to this relation, neutral line current must be higher than phase current value.

C. Part 3.3

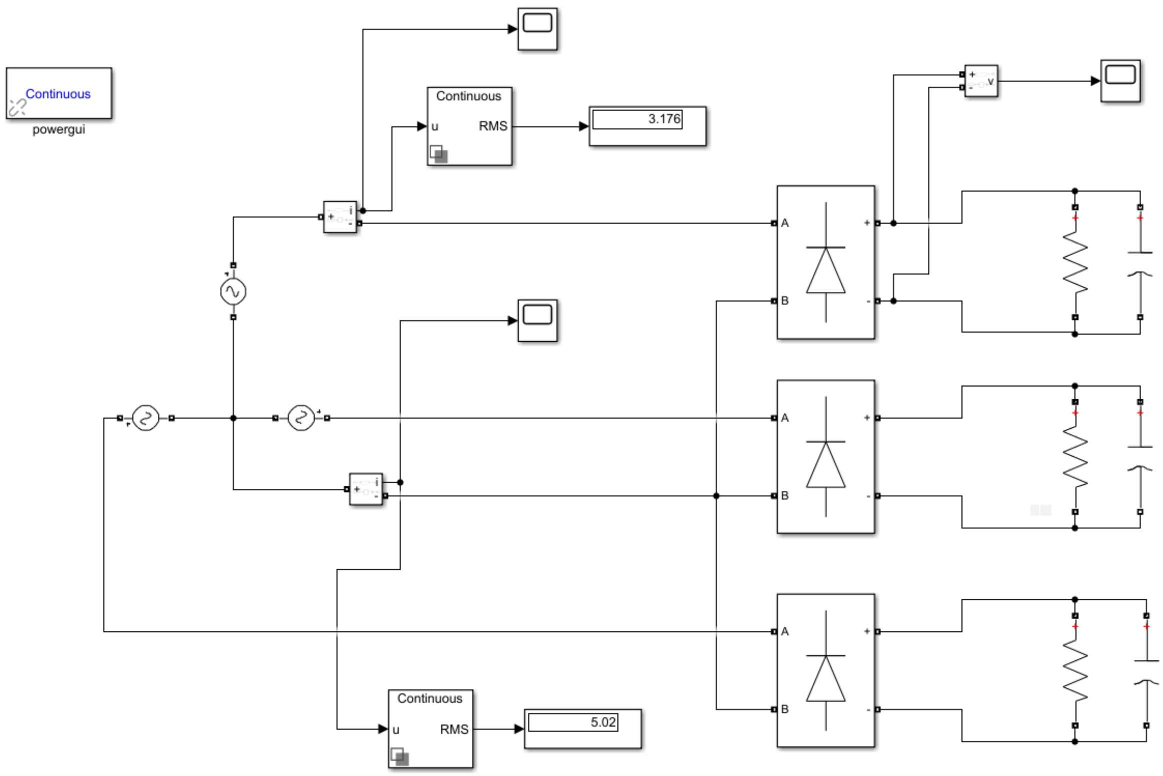


Figure 25: The whole schematic of single-phase diode rectifiers operated from a three-phase grid with neutral connection without Ls

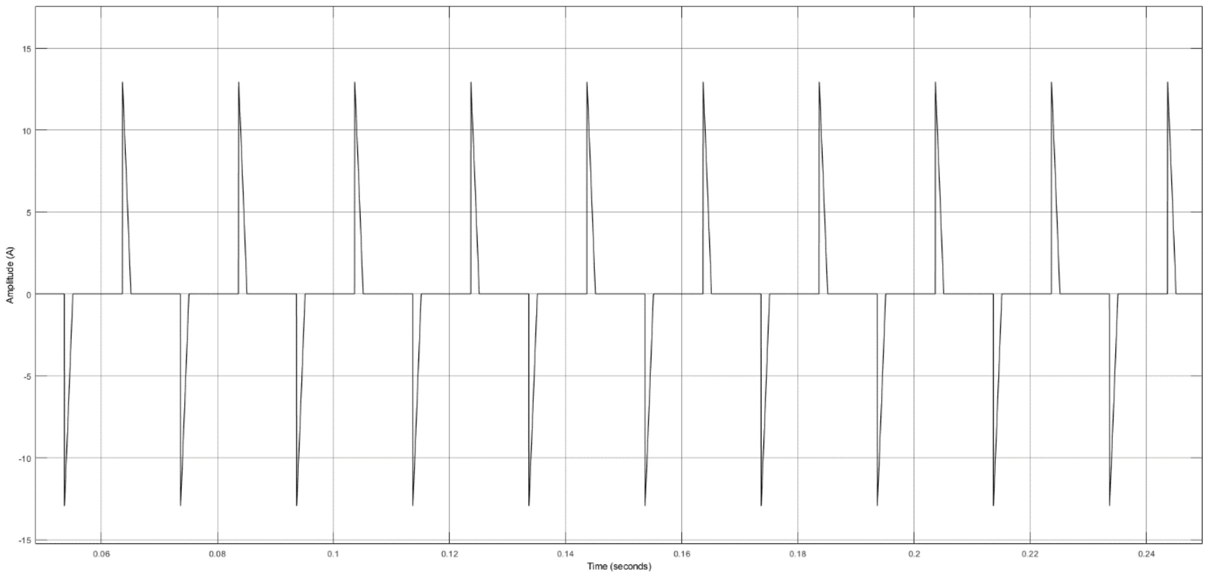


Figure 26: The phase A current characteristic of circuit without Ls

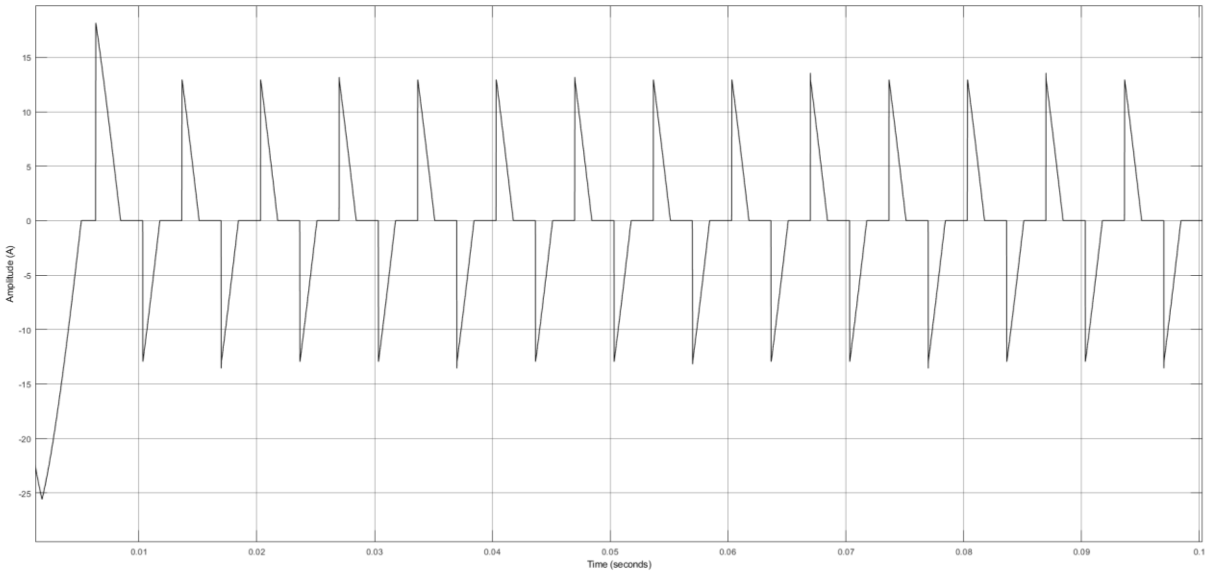


Figure 27: The neutral line current characteristic of circuit without Ls

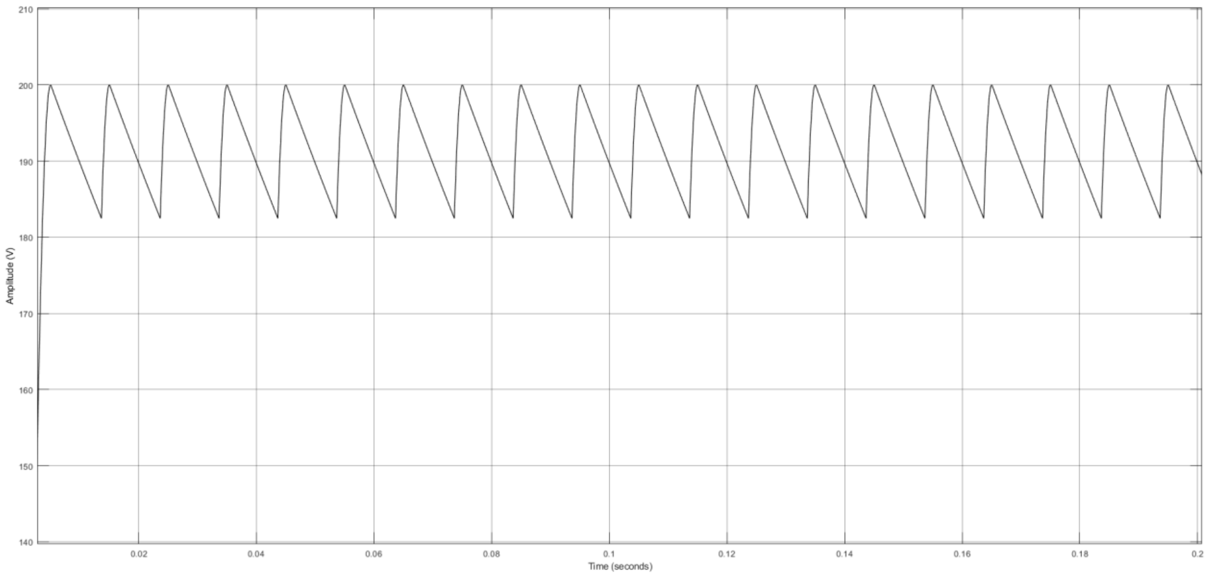


Figure 28: The output voltage waveform of diode bridge without Ls.

As seen in Figure 24;

- RMS value of line current = 3.176 A
- RMS value of neutral line = 5.02 A

III. CONCLUSION

In this project, we implemented single phase diode rectifier with different loads and operated from three phase grid by using MATLAB Simulink. We observed diode working principle, THD distribution, commutation related with inductive load on voltage and current waveforms. Furthermore, phase and neutral line current differences and output voltage is also examined for three phase circuit. During the process, we got a lot of experiences about usage and basic working tools of Simulink. While completing the project, we also used GitHub version control system. This tool will be really helpful for business in the future.

After that, we can design the diode rectifiers single or three phase by using Simulink, and observe their characteristic which we are working on thanks to this project

APPENDIX

Datasheets of the chosen components are provided.

Type SLPX 85 °C Snap-In Aluminum Electrolytic

Best Value 85 °C Snap-In Type

Type SLPX is the best value package snap-in series for 85 ºC, 3000 h operation. This series is the most cost-effective choice for DC filtering and power supply applications where long life and high ripple capability are needed.

Highlights

- 3000 h ripple load life at rated voltage
- 85 ºC rated
- Small case size with high capacitance
- Best for switching power supplies
- 22 mm to 35 mm diameter, 10 mm lead spacing
- Great value snap-in type
- High ripple current

Specifications

<table>
<tr><td>Temperature Range</td><td>–40 ºC to +85 ºC ≤ 250 Vdc
–25 ºC to +85 ºC ≥ 315 Vdc</td></tr>
<tr><td>Rated Voltage Range</td><td>10 Vdc to 450 Vdc</td></tr>
<tr><td>Capacitance Range</td><td>68 µF to 82,000 µF</td></tr>
<tr><td>Capacitance Tolerance</td><td>±20%</td></tr>
<tr><td>Leakage Current</td><td>≤ 3 $\sqrt{CV}$ µA at 5 minutes</td></tr>
<tr><td>Ripple Current Multipliers</td><td>Ambient Temperature
<table>
<tr><th>20 ºC - 45 ºC</th><th>55 ºC</th><th>65 ºC - 75 ºC</th><th>85 ºC</th></tr>
<tr><td>1.58</td><td>1.41</td><td>1.22</td><td>1.00</td></tr>
</table>
Frequency
<table>
<tr><th>Voltage</th><th>60 Hz</th><th>120 Hz</th><th>1 kHz</th><th>10 kHz & Up</th></tr>
<tr><td>10 - 100 Vdc</td><td>0.90</td><td>1.00</td><td>1.15</td><td>1.25</td></tr>
<tr><td>160 - 450 Vdc</td><td>0.80</td><td>1.00</td><td>1.15</td><td>1.47</td></tr>
</table>
To apply multipliers, see ratings tables for ripple current values</td></tr>
<tr><td>Low Temperature Characteristics</td><td>Impedance ratio: $Z_{-20ºC}/Z_{+25ºC}$
≤ 10 (10 Vdc)
≤ 8 (16–50 Vdc)
≤ 4 (63–100 Vdc)
≤ 3 (150–450 Vdc)</td></tr>
<tr><td>Endurance Life</td><td>3,000 h @ full load @ 85 ºC
Δ Capacitance ±20%
ESR ≤200% of limit
DCL 100 % of limit</td></tr>
<tr><td>Shelf Life</td><td>1,000 h @ 85 ºC
Δ Capacitance ±15%
ESR ≤150% of limit
DCL 100 % of limit</td></tr>
<tr><td>Vibration</td><td>10 Hz to 55 Hz 0.06” and 10g max 2 h in each plane</td></tr>
<tr><td colspan="2">RoHS Compliant</td></tr>
</table>

Type SLPX 85 °C Snap-In Aluminum Electrolytic

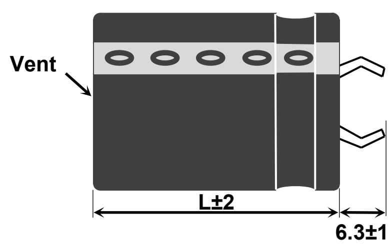
Best Value 85 °C Snap-In Type

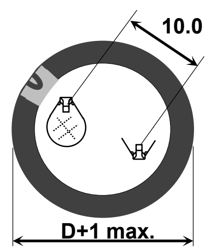
Part Numbering System

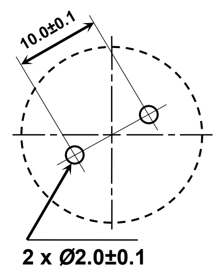
SLPX	562	M	025	A1	P	3	A
Type	Cap	Tolerance	Voltage	Case Code	Polarity	Insulating Sleeve	Pin Style
SLPX	**821** = 820 µF **332** = 3300 µF **103** = 10,000 µF	**M =** ±20%	**025** = 25 Vdc **250** = 250 Vdc		**P** = Polarized	**3** = PVC	**Blank** = 2 pins snap-in 6.3 mm L **A** = 2 pins snap-in 4.0 mm L

Diameter		Length mm (in)					
		25	30	35	40	45	50
mm	(in)	(1.00)	(1.18)	(1.38)	(1.57)	(1.77)	(2.00)
22	(0.87)	A1	A3	A5	A7	A4	A9
25	(1.00)	C1	C3	C5	C7	C4	C9
30	(1.18)	E1	E3	E5	E7	E4	E9
35	(1.38)	H1	H3	H5	H7	H4	H9

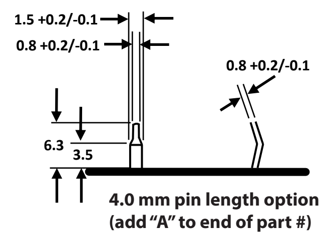
Outline Drawing







PC Board Mounting Holes



Ratings

Additional Voltages and Sizes available at www.cde.com/catalogs/SLPX.pdf

Cap (µF)	3000 h @ 85 °C Catalog Part Number	Max 25 °C ESR (Ω) 120 Hz	Max 25 °C ESR (Ω) 20kHz	Max 85 °C Ripple (A_{rms}) 120 Hz	Max 85 °C Ripple (A_{rms}) 20kHz	Nominal Size (DxL) (mm)
10 Vdc (13 Vdc Surge)						
12000	SLPX123M010A1P3	0.061	0.046	2.41	3.01	22 x 25
15000	SLPX153M010A3P3	0.049	0.037	2.88	3.60	22 x 30
15000	SLPX153M010C1P3	0.049	0.037	2.88	3.60	25 x 25
18000	SLPX183M010A5P3	0.041	0.031	3.22	4.03	22 x 35
18000	SLPX183M010C3P3	0.041	0.031	3.08	3.85	25 x 30
22000	SLPX223M010A7P3	0.033	0.025	3.79	4.74	22 x 40
22000	SLPX223M010C3P3	0.033	0.025	3.66	4.58	25 x 30
22000	SLPX223M010E1P3	0.033	0.025	3.53	4.41	30 x 25
27000	SLPX273M010A4P3	0.027	0.020	4.04	5.05	22 x 45
27000	SLPX273M010C5P3	0.027	0.020	4.04	5.05	25 x 35
27000	SLPX273M010E3P3	0.027	0.020	3.99	4.99	30 x 30
33000	SLPX333M010A9P3	0.022	0.017	4.58	5.73	22 x 50
33000	SLPX333M010C7P3	0.022	0.017	4.56	5.70	25 x 40
33000	SLPX333M010E3P3	0.022	0.017	4.58	5.73	30 x 30
39000	SLPX393M010C4P3	0.019	0.014	5.29	6.61	25 x 45
39000	SLPX393M010E5P3	0.019	0.014	5.21	6.51	30 x 35
39000	SLPX393M010H3P3	0.019	0.014	5.50	6.88	35 x 30
47000	SLPX473M010C9P3	0.016	0.012	5.78	7.23	25 x 50
47000	SLPX473M010E7P3	0.016	0.012	5.78	7.23	30 x 40
47000	SLPX473M010H5P3	0.016	0.012	5.55	6.94	35 x 35
56000	SLPX563M010E4P3	0.013	0.010	6.59	8.24	30 x 45
56000	SLPX563M010H5P3	0.013	0.010	6.40	8.00	35 x 35

Cap (µF)	3000 h @ 85 °C Catalog Part Number	Max 25 °C ESR (Ω) 120 Hz	Max 25 °C ESR (Ω) 20kHz	Max 85 °C Ripple (A_{rms}) 120 Hz	Max 85 °C Ripple (A_{rms}) 20kHz	Nominal Size (DxL) (mm)
10 Vdc (13 Vdc Surge)						
68000	SLPX683M010E9P3	0.011	0.008	7.50	9.38	30 x 50
68000	SLPX683M010H7P3	0.011	0.008	7.48	9.35	35 x 40
82000	SLPX823M010H9P3	0.009	0.007	8.50	10.63	35 x 50
16 Vdc (20 Vdc Surge)						
8200	SLPX822M016A1P3	0.081	0.061	2.56	3.20	22 x 25
10000	SLPX103M016A3P3	0.066	0.050	2.89	3.61	22 x 30
12000	SLPX123M016A3P3	0.055	0.041	3.13	3.91	22 x 30
12000	SLPX123M016C1P3	0.055	0.041	3.01	3.76	25 x 25
15000	SLPX153M016A5P3	0.044	0.033	3.69	4.61	22 x 35
15000	SLPX153M016C3P3	0.044	0.033	3.64	4.55	25 x 30
15000	SLPX153M016E1P3	0.044	0.033	3.73	4.66	30 x 25
18000	SLPX183M016A7P3	0.037	0.028	3.98	4.98	22 x 40
18000	SLPX183M016C5P3	0.037	0.028	3.98	4.98	25 x 35
18000	SLPX183M016E3P3	0.037	0.028	3.88	4.85	30 x 30
22000	SLPX223M016A9P3	0.030	0.023	4.52	5.65	22 x 50
22000	SLPX223M016C7P3	0.030	0.023	4.44	5.55	25 x 40
22000	SLPX223M016E3P3	0.030	0.023	4.38	5.48	30 x 30
27000	SLPX273M016C4P3	0.025	0.019	4.98	6.23	25 x 45
27000	SLPX273M016E5P3	0.025	0.019	4.95	6.19	30 x 35
27000	SLPX273M016H3P3	0.025	0.019	4.82	6.03	35 x 30
33000	SLPX333M016C9P3	0.020	0.015	5.49	6.86	25 x 50
33000	SLPX333M016E7P3	0.020	0.015	5.60	7.00	30 x 40

Type SLPX 85 °C Snap-In Aluminum Electrolytic

Best Value 85 °C Snap-In Type

Cap (µF)	3000 h @ 85 ºC Catalog Part Number	Max 25 °C ESR (Ω) 120 Hz	Max 25 °C ESR (Ω) 20kHz	Max 85 °C Ripple (A_{rms}) 120 Hz	Max 85 °C Ripple (A_{rms}) 20kHz	Nominal Size (DxL) (mm)
16 Vdc (20 Vdc Surge)						
33000	SLPX333M016H3P3	0.020	0.015	5.46	6.83	35 x 30
39000	SLPX393M016E4P3	0.017	0.013	6.21	7.76	30 x 45
39000	SLPX393M016H5P3	0.017	0.013	6.12	7.65	35 x 35
47000	SLPX473M016E9P3	0.014	0.011	6.93	8.66	30 x 50
47000	SLPX473M016H7P3	0.014	0.011	6.89	8.61	35 x 40
56000	SLPX563M016H4P3	0.012	0.009	7.69	9.61	35 x 45
25 Vdc (32 Vdc Surge)						
5600	SLPX562M025A1P3	0.107	0.080	2.31	2.89	22 x 25
6800	SLPX682M025A3P3	0.088	0.066	2.56	3.20	22 x 30
8200	SLPX822M025A5P3	0.073	0.055	2.86	3.58	22 x 35
8200	SLPX822M025C1P3	0.073	0.055	2.78	3.48	25 x 25
10000	SLPX103M025A5P3	0.060	0.045	3.31	4.14	22 x 35
10000	SLPX103M025C3P3	0.060	0.045	3.16	3.95	25 x 30
10000	SLPX103M025E1P3	0.060	0.045	3.28	4.10	30 x 25
12000	SLPX123M025A7P3	0.050	0.038	3.77	4.71	22 x 40
12000	SLPX123M025C5P3	0.050	0.038	3.63	4.54	25 x 35
12000	SLPX123M025E1P3	0.050	0.038	3.80	4.75	30 x 25
15000	SLPX153M025A9P3	0.040	0.030	4.21	5.26	22 x 50
15000	SLPX153M025C7P3	0.040	0.030	4.10	5.13	25 x 40
15000	SLPX153M025E3P3	0.040	0.030	4.00	5.00	30 x 30
18000	SLPX183M025C4P3	0.033	0.025	4.68	5.85	25 x 45
18000	SLPX183M025E5P3	0.033	0.025	4.66	5.83	30 x 35
18000	SLPX183M025H3P3	0.033	0.025	4.68	5.85	35 x 30
22000	SLPX223M025C9P3	0.027	0.020	5.29	6.61	25 x 50
22000	SLPX223M025E7P3	0.027	0.020	5.33	6.66	30 x 40
22000	SLPX223M025H5P3	0.027	0.020	5.26	6.58	35 x 35
27000	SLPX273M025E4P3	0.022	0.017	6.02	7.53	30 x 45
27000	SLPX273M025H7P3	0.022	0.017	6.02	7.53	35 x 40
33000	SLPX333M025E9P3	0.018	0.014	5.29	6.61	30 x 50
33000	SLPX333M025H4P3	0.018	0.014	6.75	8.44	35 x 45
39000	SLPX393M025H9P3	0.015	0.011	7.56	9.45	35 x 50
35 Vdc (44 Vdc Surge)						
3900	SLPX392M035A1P3	0.136	0.102	2.22	2.78	22 x 25
4700	SLPX472M035A3P3	0.113	0.085	2.46	3.08	22 x 30
4700	SLPX472M035C1P3	0.113	0.085	2.43	3.04	25 x 25
5600	SLPX562M035A3P3	0.095	0.071	2.61	3.26	22 x 30
5600	SLPX562M035A5P3	0.095	0.071	2.79	3.49	22 x 35
5600	SLPX562M035C3P3	0.095	0.071	2.75	3.44	25 x 30
6800	SLPX682M035A7P3	0.078	0.059	2.97	3.71	22 x 40
6800	SLPX682M035C3P3	0.078	0.059	2.89	3.61	25 x 30
6800	SLPX682M035E1P3	0.078	0.059	3.09	3.86	30 x 25
8200	SLPX822M035A4P3	0.065	0.049	3.47	4.34	22 x 45
8200	SLPX822M035C5P3	0.065	0.049	3.33	4.16	25 x 35
8200	SLPX822M035E3P3	0.065	0.049	3.29	4.11	30 x 30
10000	SLPX103M035A9P3	0.053	0.040	3.75	4.69	22 x 50

Cap (µF)	3000 h @ 85 ºC Catalog Part Number	Max 25 °C ESR (Ω) 120 Hz	Max 25 °C ESR (Ω) 20kHz	Max 85 °C Ripple (A_{rms}) 120 Hz	Max 85 °C Ripple (A_{rms}) 20kHz	Nominal Size (DxL) (mm)
35 Vdc (44 Vdc Surge)						
10000	SLPX103M035C7P3	0.053	0.040	3.65	4.56	25 x 40
10000	SLPX103M035E3P3	0.053	0.040	3.61	4.51	30 x 30
12000	SLPX123M035C4P3	0.044	0.033	4.15	5.19	25 x 45
12000	SLPX123M035E5P3	0.044	0.033	4.14	5.18	30 x 35
12000	SLPX123M035H3P3	0.044	0.033	4.27	5.34	35 x 30
15000	SLPX153M035C9P3	0.035	0.026	4.77	5.96	25 x 50
15000	SLPX153M035E7P3	0.035	0.026	4.80	6.00	30 x 40
15000	SLPX153M035H5P3	0.035	0.026	4.95	6.19	35 x 35
18000	SLPX183M035E4P3	0.029	0.022	5.30	6.63	30 x 45
18000	SLPX183M035H7P3	0.029	0.022	5.71	7.14	35 x 40
22000	SLPX223M035H4P3	0.024	0.018	6.38	7.98	35 x 45
27000	SLPX273M035H9P3	0.020	0.015	6.90	8.63	35 x 50
50 Vdc (63 Vdc Surge)						
2200	SLPX222M050A1P3	0.211	0.158	1.93	2.41	22 x 25
2700	SLPX272M050A3P3	0.172	0.129	2.21	2.76	22 x 30
3300	SLPX332M050A3P3	0.141	0.106	2.41	3.01	22 x 30
3300	SLPX332M050C1P3	0.141	0.106	2.38	2.98	25 x 25
3900	SLPX392M050A5P3	0.119	0.089	2.72	3.40	22 x 35
3900	SLPX392M050C3P3	0.119	0.089	2.68	3.35	25 x 30
4700	SLPX472M050A7P3	0.099	0.074	3.02	3.78	22 x 40
4700	SLPX472M050C3P3	0.099	0.074	3.07	3.84	25 x 30
4700	SLPX472M050E1P3	0.099	0.074	3.01	3.76	30 x 25
5600	SLPX562M050A7P3	0.083	0.062	3.26	4.08	22 x 40
5600	SLPX562M050A4P3	0.083	0.062	3.43	4.29	22 x 45
5600	SLPX562M050C5P3	0.083	0.062	3.47	4.34	25 x 35
5600	SLPX562M050E3P3	0.083	0.062	3.43	4.29	30 x 30
6800	SLPX682M050A9P3	0.068	0.051	3.94	4.93	22 x 50
6800	SLPX682M050C7P3	0.068	0.051	3.87	4.84	25 x 40
6800	SLPX682M050E5P3	0.068	0.051	3.93	4.91	30 x 35
8200	SLPX822M050C4P3	0.057	0.043	4.44	5.55	25 x 45
8200	SLPX822M050E5P3	0.057	0.043	4.47	5.59	30 x 35
8200	SLPX822M050H3P3	0.057	0.043	4.41	5.51	35 x 30
10000	SLPX103M050E7P3	0.046	0.035	5.08	6.35	30 x 40
10000	SLPX103M050H5P3	0.046	0.035	4.92	6.15	35 x 35
12000	SLPX123M050E9P3	0.039	0.029	5.72	7.15	30 x 50
12000	SLPX123M050H7P3	0.039	0.029	5.69	7.11	35 x 40
15000	SLPX153M050H4P3	0.031	0.023	6.56	8.20	35 x 45
18000	SLPX183M050H9P3	0.026	0.020	7.14	8.93	35 x 50
22000	SLPX223M050H9P3	0.021	0.016	7.89	9.86	35 x 50
63 Vdc (79 Vdc Surge)						
1800	SLPX182M063A1P3	0.221	0.166	1.90	2.38	22 x 25
2200	SLPX222M063A3P3	0.181	0.136	2.35	2.94	22 x 30
2200	SLPX222M063C1P3	0.181	0.136	2.30	2.88	25 x 25
2700	SLPX272M063A5P3	0.147	0.110	2.50	3.13	22 x 35
2700	SLPX272M063C3P3	0.147	0.110	2.52	3.15	25 x 30

Type SLPX 85 °C Snap-In Aluminum Electrolytic

Best Value 85 °C Snap-In Type

Cap (µF)	3000 h @ 85 °C Catalog Part Number	Max 25 °C ESR (Ω) 120 Hz	Max 25 °C ESR (Ω) 20kHz	Max 85 °C Ripple (A_{rms}) 120 Hz	Max 85 °C Ripple (A_{rms}) 20kHz	Nominal Size (DxL) (mm)
63 Vdc (79 Vdc Surge)						
3300	SLPX332M063A7P3	0.121	0.091	2.72	3.40	22 x 40
3300	SLPX332M063C3P3	0.121	0.091	2.74	3.43	25 x 30
3300	SLPX332M063E1P3	0.121	0.091	2.78	3.48	30 x 25
3900	SLPX392M063A4P3	0.102	0.077	3.09	3.86	22 x 45
3900	SLPX392M063C5P3	0.102	0.077	3.13	3.91	25 x 35
3900	SLPX392M063E3P3	0.102	0.077	3.09	3.86	30 x 30
4700	SLPX472M063A9P3	0.085	0.064	3.69	4.61	22 x 50
4700	SLPX472M063C7P3	0.085	0.064	3.59	4.49	25 x 40
4700	SLPX472M063E3P3	0.085	0.064	3.54	4.43	30 x 30
5600	SLPX562M063C4P3	0.071	0.053	4.01	5.01	25 x 45
5600	SLPX562M063E5P3	0.071	0.053	4.00	5.00	30 x 35
5600	SLPX562M063H3P3	0.071	0.053	3.75	4.69	35 x 30
6800	SLPX682M063C9P3	0.059	0.044	4.52	5.65	25 x 50
6800	SLPX682M063E7P3	0.059	0.044	4.55	5.69	30 x 40
6800	SLPX682M063H3P3	0.059	0.044	4.44	5.55	35 x 30
8200	SLPX822M063E4P3	0.049	0.037	5.12	6.40	30 x 45
8200	SLPX822M063H5P3	0.049	0.037	5.05	6.31	35 x 35
10000	SLPX103M063E9P3	0.040	0.030	5.78	7.23	30 x 50
10000	SLPX103M063H7P3	0.040	0.030	5.75	7.19	35 x 40
12000	SLPX123M063E9P3	0.033	0.025	6.20	7.75	30 x 50
12000	SLPX123M063H4P3	0.033	0.025	6.47	8.09	35 x 45
12000	SLPX123M063H9P3	0.033	0.025	6.76	8.45	35 x 50
80 Vdc (100 Vdc Surge)						
1200	SLPX122M080A1P3	0.276	0.207	1.77	2.21	22 x 25
1500	SLPX152M080A3P3	0.221	0.166	2.01	2.51	22 x 30
1800	SLPX182M080A3P3	0.184	0.138	2.11	2.64	22 x 30
1800	SLPX182M080C1P3	0.184	0.138	2.26	2.83	25 x 25
2200	SLPX222M080A7P3	0.151	0.113	2.53	3.16	22 x 40
2200	SLPX222M080C3P3	0.151	0.113	2.53	3.16	25 x 30
2200	SLPX222M080E1P3	0.151	0.113	2.56	3.20	30 x 25
2700	SLPX272M080A4P3	0.123	0.092	2.93	3.66	22 x 45
2700	SLPX272M080C5P3	0.123	0.092	2.93	3.66	25 x 35
2700	SLPX272M080E3P3	0.123	0.092	2.91	3.64	30 x 30
3300	SLPX332M080A9P3	0.101	0.076	3.23	4.04	22 x 50
3300	SLPX332M080C7P3	0.101	0.076	3.29	4.11	25 x 40
3300	SLPX332M080E3P3	0.101	0.076	3.25	4.06	30 x 30
3900	SLPX392M080C4P3	0.085	0.064	3.62	4.53	25 x 45
3900	SLPX392M080E5P3	0.085	0.064	3.70	4.63	30 x 35
4700	SLPX472M080C9P3	0.071	0.053	4.28	5.35	25 x 50
4700	SLPX472M080E7P3	0.071	0.053	4.23	5.29	30 x 40
4700	SLPX472M080H3P3	0.071	0.053	4.12	5.15	35 x 30
5600	SLPX562M080E4P3	0.059	0.044	4.70	5.88	30 x 45
5600	SLPX562M080H5P3	0.059	0.044	4.64	5.80	35 x 35
6800	SLPX682M080E9P3	0.049	0.037	5.27	6.59	30 x 50
6800	SLPX682M080H7P3	0.049	0.037	5.24	6.55	35 x 40

Cap (µF)	3000 h @ 85 °C Catalog Part Number	Max 25 °C ESR (Ω) 120 Hz	Max 25 °C ESR (Ω) 20kHz	Max 85 °C Ripple (A_{rms}) 120 Hz	Max 85 °C Ripple (A_{rms}) 20kHz	Nominal Size (DxL) (mm)
80 Vdc (100 Vdc Surge)						
8200	SLPX822M080H4P3	0.040	0.030	5.89	7.36	35 x 45
10000	SLPX103M080H9P3	0.033	0.025	6.63	8.29	35 x 50
100 Vdc (125 Vdc Surge)						
820	SLPX821M100A1P3	0.324	0.243	1.86	2.33	22 x 25
1000	SLPX102M100A3P3	0.265	0.199	2.02	2.53	22 x 30
1200	SLPX122M100A3P3	0.221	0.166	2.12	2.65	22 x 30
1200	SLPX122M100C1P3	0.221	0.166	2.11	2.64	25 x 25
1500	SLPX152M100A5P3	0.177	0.133	2.45	3.06	22 x 35
1500	SLPX152M100C3P3	0.177	0.133	2.47	3.09	25 x 30
1800	SLPX182M100A7P3	0.147	0.110	2.77	3.46	22 x 40
1800	SLPX182M100C5P3	0.147	0.110	2.81	3.51	25 x 35
1800	SLPX182M100E1P3	0.147	0.110	2.65	3.31	30 x 25
2200	SLPX222M100A4P3	0.121	0.091	3.15	3.94	22 x 45
2200	SLPX222M100C7P3	0.121	0.091	3.21	4.01	25 x 40
2200	SLPX222M100E3P3	0.121	0.091	3.17	3.96	30 x 30
2700	SLPX272M100C4P3	0.098	0.074	3.66	4.58	25 x 45
2700	SLPX272M100E5P3	0.098	0.074	3.65	4.56	30 x 35
2700	SLPX272M100H3P3	0.098	0.074	3.77	4.71	35 x 30
3300	SLPX332M100C9P3	0.080	0.060	4.15	5.19	25 x 50
3300	SLPX332M100E7P3	0.080	0.060	4.18	5.23	30 x 40
3300	SLPX332M100H5P3	0.080	0.060	4.07	5.09	35 x 35
3900	SLPX392M100E4P3	0.068	0.051	4.67	5.84	30 x 45
3900	SLPX392M100H5P3	0.068	0.051	4.61	5.76	35 x 35
4700	SLPX472M100H7P3	0.056	0.042	5.23	6.54	35 x 40
4700	SLPX472M100E9P3	0.056	0.042	5.26	6.58	30 x 50
5600	SLPX562M100H4P3	0.047	0.035	5.88	7.35	35 x 45
6800	SLPX682M100H9P3	0.039	0.029	6.01	7.51	35 x 50
160 Vdc (200 Vdc Surge)						
390	SLPX391M160A1P3	0.510	0.383	1.63	2.40	22 x 25
470	SLPX471M160A3P3	0.423	0.317	1.86	2.73	22 x 30
470	SLPX471M160C1P3	0.423	0.317	1.86	2.73	25 x 25
560	SLPX561M160A3P3	0.355	0.266	2.15	3.16	22 x 30
560	SLPX561M160C3P3	0.355	0.266	2.15	3.16	25 x 30
680	SLPX681M160A7P3	0.293	0.220	2.35	3.45	22 x 40
680	SLPX681M160C3P3	0.293	0.220	2.33	3.43	25 x 30
680	SLPX681M160E1P3	0.293	0.220	2.33	3.43	30 x 25
820	SLPX821M160A4P3	0.243	0.182	2.68	3.94	22 x 45
820	SLPX821M160C5P3	0.243	0.182	2.65	3.90	25 x 35
820	SLPX821M160E3P3	0.243	0.182	2.64	3.88	30 x 30
1000	SLPX102M160A9P3	0.199	0.149	3.02	4.44	22 x 50
1000	SLPX102M160C7P3	0.199	0.149	3.00	4.41	25 x 40
1000	SLPX102M160E3P3	0.199	0.149	2.96	4.35	30 x 30
1200	SLPX122M160C4P3	0.166	0.125	3.43	5.04	25 x 45
1200	SLPX122M160E5P3	0.166	0.125	3.41	5.01	30 x 35
1200	SLPX122M160H3P3	0.166	0.125	3.40	5.00	35 x 30

Type SLPX 85 °C Snap-In Aluminum Electrolytic

Best Value 85 °C Snap-In Type

Cap (µF)	3000 h @ 85 ºC Catalog Part Number	Max 25 °C ESR (Ω) 120 Hz	Max 25 °C ESR (Ω) 20kHz	Max 85 °C Ripple (A_{rms}) 120 Hz	Max 85 °C Ripple (A_{rms}) 20kHz	Nominal Size (DxL) (mm)
160 Vdc (200 Vdc Surge)						
1500	SLPX152M160E7P3	0.133	0.100	3.96	5.82	30 x 40
1500	SLPX152M160H5P3	0.133	0.100	3.94	5.79	35 x 35
1800	SLPX182M160E4P3	0.111	0.083	4.31	6.34	30 x 45
1800	SLPX182M160H5P3	0.111	0.083	4.28	6.29	35 x 35
2200	SLPX222M160H7P3	0.090	0.068	4.96	7.29	35 x 40
2700	SLPX272M160H9P3	0.074	0.056	5.57	8.19	35 x 50
180 Vdc (225 Vdc Surge)						
330	SLPX331M180A1P3	0.603	0.452	1.49	2.19	22 x 25
390	SLPX391M180A1P3	0.510	0.383	1.84	2.70	22 x 25
470	SLPX471M180A3P3	0.423	0.317	1.91	2.81	22 x 30
470	SLPX471M180C1P3	0.423	0.317	2.08	3.06	25 x 25
560	SLPX561M180A5P3	0.355	0.266	2.25	3.31	22 x 35
560	SLPX561M180C1P3	0.355	0.266	2.25	3.31	25 x 25
680	SLPX681M180A5P3	0.293	0.220	2.48	3.65	22 x 35
680	SLPX681M180C3P3	0.293	0.220	2.50	3.68	25 x 30
680	SLPX681M180E1P3	0.293	0.220	2.46	3.62	30 x 25
820	SLPX821M180A7P3	0.243	0.182	2.86	4.20	22 x 40
820	SLPX821M180C5P3	0.243	0.182	2.75	4.04	25 x 35
820	SLPX821M180E1P3	0.243	0.182	2.69	3.95	30 x 25
1000	SLPX102M180C7P3	0.199	0.149	3.06	4.50	25 x 40
1000	SLPX102M180E3P3	0.199	0.149	3.10	4.56	30 x 30
1200	SLPX122M180C4P3	0.166	0.125	3.63	5.34	25 x 45
1200	SLPX122M180E5P3	0.166	0.125	3.55	5.22	30 x 35
1200	SLPX122M180H3P3	0.166	0.125	3.49	5.13	35 x 30
1500	SLPX152M180E7P3	0.133	0.100	4.10	6.03	30 x 40
1500	SLPX152M180H5P3	0.133	0.100	4.02	5.91	35 x 35
1800	SLPX182M180E4P3	0.111	0.083	4.55	6.69	30 x 45
1800	SLPX182M180H5P3	0.111	0.083	4.54	6.67	35 x 35
2200	SLPX222M180H7P3	0.090	0.068	4.83	6.04	35 x 40
2700	SLPX272M180H9P3	0.074	0.056	5.30	6.63	35 x 50
200 Vdc (250 Vdc Surge)						
270	SLPX271M200A1P3	0.737	0.553	1.37	2.01	22 x 25
330	SLPX331M200A3P3	0.603	0.452	1.63	2.40	22 x 30
330	SLPX331M200A1P3	0.603	0.452	1.51	2.22	22 x 25
390	SLPX391M200A3P3	0.510	0.383	1.73	2.54	22 x 30
390	SLPX391M200C1P3	0.510	0.383	1.71	2.51	25 x 25
470	SLPX471M200A3P3	0.423	0.317	1.97	2.90	22 x 30
470	SLPX471M200C3P3	0.423	0.317	1.95	2.87	25 x 30
560	SLPX561M200A7P3	0.355	0.266	2.18	3.20	22 x 40
560	SLPX561M200C3P3	0.355	0.266	2.15	3.16	25 x 30
560	SLPX561M200E1P3	0.355	0.266	2.15	3.16	30 x 25
680	SLPX681M200A4P3	0.293	0.220	2.48	3.65	22 x 45
680	SLPX681M200C5P3	0.293	0.220	2.48	3.65	25 x 35
680	SLPX681M200E3P3	0.293	0.220	2.48	3.65	30 x 30
820	SLPX821M200A9P3	0.243	0.182	2.81	4.13	22 x 50

Cap (µF)	3000 h @ 85 ºC Catalog Part Number	Max 25 °C ESR (Ω) 120 Hz	Max 25 °C ESR (Ω) 20kHz	Max 85 °C Ripple (A_{rms}) 120 Hz	Max 85 °C Ripple (A_{rms}) 20kHz	Nominal Size (DxL) (mm)
200 Vdc (250 Vdc Surge)						
820	SLPX821M200C7P3	0.243	0.182	2.79	4.10	25 x 40
820	SLPX821M200E3P3	0.243	0.182	2.75	4.04	30 x 30
1000	SLPX102M200C4P3	0.199	0.149	3.28	4.82	25 x 45
1000	SLPX102M200E5P3	0.199	0.149	3.15	4.63	30 x 35
1000	SLPX102M200H3P3	0.199	0.149	3.25	4.78	35 x 30
1200	SLPX122M200C9P3	0.166	0.125	3.61	5.31	25 x 50
1200	SLPX122M200E7P3	0.166	0.125	3.61	5.31	30 x 40
1200	SLPX122M200E4P3	0.166	0.125	3.80	5.59	30 x 45
1200	SLPX122M200H5P3	0.166	0.125	3.57	5.25	35 x 35
1500	SLPX152M200E4P3	0.133	0.100	4.13	6.07	30 x 45
1500	SLPX152M200H5P3	0.133	0.100	3.85	5.66	35 x 35
1500	SLPX152M200H7P3	0.133	0.100	4.06	5.97	35 x 40
1500	SLPX152M200H4P3	0.133	0.100	4.26	6.26	35 x 45
1800	SLPX182M200H4P3	0.111	0.083	4.59	6.75	35 x 45
2200	SLPX222M200H9P3	0.090	0.068	5.25	7.72	35 x 50
220 Vdc (270 Vdc Surge)						
220	SLPX221M220A1P3	0.905	0.679	1.30	1.91	22 x 25
270	SLPX271M220A1P3	0.737	0.553	1.42	2.09	22 x 25
330	SLPX331M220A3P3	0.603	0.452	1.59	2.34	22 x 30
330	SLPX331M220C1P3	0.603	0.452	1.59	2.34	25 x 25
390	SLPX391M220A5P3	0.510	0.383	1.80	2.65	22 x 35
390	SLPX391M220C1P3	0.510	0.383	1.75	2.57	25 x 25
470	SLPX471M220A5P3	0.423	0.317	2.06	3.03	22 x 35
470	SLPX471M220C3P3	0.423	0.317	2.08	3.06	25 x 30
470	SLPX471M220E1P3	0.423	0.317	2.16	3.18	30 x 25
560	SLPX561M220A7P3	0.355	0.266	2.22	3.26	22 x 40
560	SLPX561M220C5P3	0.355	0.266	2.38	3.50	25 x 35
560	SLPX561M220E1P3	0.355	0.266	2.18	3.20	30 x 25
680	SLPX681M220A4P3	0.293	0.220	2.62	3.85	22 x 45
680	SLPX681M220C7P3	0.293	0.220	2.56	3.76	25 x 40
680	SLPX681M220E3P3	0.293	0.220	2.52	3.70	30 x 30
820	SLPX821M220C4P3	0.243	0.182	2.91	4.28	25 x 45
820	SLPX821M220E5P3	0.243	0.182	2.84	4.17	30 x 35
820	SLPX821M220H3P3	0.243	0.182	2.79	4.10	35 x 35
1000	SLPX102M220C9P3	0.199	0.149	3.53	5.19	25 x 50
1000	SLPX102M220E7P3	0.199	0.149	3.36	4.94	30 x 40
1000	SLPX102M220H3P3	0.199	0.149	3.29	4.84	35 x 30
1200	SLPX122M220E7P3	0.166	0.125	3.54	5.20	30 x 40
1200	SLPX122M220E4P3	0.166	0.125	3.72	5.47	30 x 45
1200	SLPX122M220H5P3	0.166	0.125	3.68	5.41	35 x 35
1500	SLPX152M220H7P3	0.133	0.100	4.10	5.13	35 x 40
1800	SLPX182M220H4P3	0.111	0.083	4.52	5.65	35 x 45
250 Vdc (300 Vdc Surge)						
220	SLPX221M250A1P3	0.905	0.679	1.24	1.82	22 x 25
270	SLPX271M250A3P3	0.737	0.553	1.50	2.21	22 x 30

Type SLPX 85 °C Snap-In Aluminum Electrolytic

Best Value 85 °C Snap-In Type

Cap (µF)	3000 h @ 85 ºC Catalog Part Number	Max 25 °C ESR (Ω) 120 Hz	Max 25 °C ESR (Ω) 20kHz	Max 85 °C Ripple (A_{rms}) 120 Hz	Max 85 °C Ripple (A_{rms}) 20kHz	Nominal Size (DxL) (mm)
250 Vdc (300 Vdc Surge)						
330	SLPX331M250A3P3	0.603	0.452	1.66	2.44	22 x 30
330	SLPX331M250C1P3	0.603	0.452	1.61	2.37	25 x 25
390	SLPX391M250A5P3	0.510	0.383	1.88	2.76	22 x 35
390	SLPX391M250C3P3	0.510	0.383	1.88	2.76	25 x 30
470	SLPX471M250A7P3	0.423	0.317	2.15	3.16	22 x 40
470	SLPX471M250C5P3	0.423	0.317	2.15	3.16	25 x 35
470	SLPX471M250E1P3	0.423	0.317	2.04	3.00	30 x 25
560	SLPX561M250A4P3	0.355	0.266	2.48	3.65	22 x 45
560	SLPX561M250C5P3	0.355	0.266	2.35	3.45	25 x 35
560	SLPX561M250E3P3	0.355	0.266	2.35	3.45	30 x 30
680	SLPX681M250C7P3	0.293	0.220	2.67	3.92	25 x 40
680	SLPX681M250E5P3	0.293	0.220	2.71	3.98	30 x 35
820	SLPX821M250C9P3	0.243	0.182	3.01	4.42	25 x 50
820	SLPX821M250E5P3	0.243	0.182	2.98	4.38	30 x 35
820	SLPX821M250H3P3	0.243	0.182	2.96	4.35	35 x 30
1000	SLPX102M250E5P3	0.199	0.149	3.20	4.70	30 x 35
1000	SLPX102M250E4P3	0.199	0.149	3.56	5.23	30 x 45
1000	SLPX102M250E9P3	0.199	0.149	3.73	5.48	30 x 50
1000	SLPX102M250H5P3	0.199	0.149	3.48	5.12	35 x 35
1200	SLPX122M250E9P3	0.166	0.125	3.99	5.87	30 x 50
1200	SLPX122M250H7P3	0.166	0.125	3.84	5.64	35 x 40
1500	SLPX152M250H4P3	0.133	0.100	4.33	6.37	35 x 45
1800	SLPX182M250H9P3	0.111	0.083	4.54	6.67	35 x 50
315 Vdc (365 Vdc Surge)						
180	SLPX181M315A3P3	1.106	0.830	1.29	1.90	22 x 30
180	SLPX181M315C1P3	1.106	0.830	1.38	2.03	25 x 25
220	SLPX221M315A5P3	0.905	0.679	1.41	2.07	22 x 35
220	SLPX221M315C3P3	0.905	0.679	1.47	2.16	25 x 30
270	SLPX271M315A7P3	0.737	0.553	1.70	2.50	22 x 40
270	SLPX271M315C3P3	0.737	0.553	1.70	2.50	25 x 30
330	SLPX331M315A4P3	0.603	0.452	1.91	2.81	22 x 45
330	SLPX331M315C5P3	0.603	0.452	1.94	2.85	25 x 35
330	SLPX331M315E3P3	0.603	0.452	1.98	2.91	30 x 30
390	SLPX391M315A9P3	0.510	0.383	2.07	3.04	22 x 50
390	SLPX391M315C7P3	0.510	0.383	2.11	3.10	25 x 40
390	SLPX391M315E3P3	0.510	0.383	2.15	3.16	30 x 30
470	SLPX471M315C4P3	0.423	0.317	2.39	3.51	25 x 45
470	SLPX471M315E5P3	0.423	0.317	2.38	3.50	30 x 35
470	SLPX471M315H3P3	0.423	0.317	2.36	3.47	35 x 30
560	SLPX561M315E7P3	0.355	0.266	2.63	3.87	30 x 40
560	SLPX561M315H5P3	0.355	0.266	2.69	3.95	35 x 35
680	SLPX681M315E4P3	0.293	0.220	2.80	4.12	30 x 45
680	SLPX681M315H7P3	0.293	0.220	3.05	4.48	35 x 40
820	SLPX821M315E9P3	0.243	0.182	3.28	4.82	30 x 50
820	SLPX821M315H4P3	0.243	0.182	3.45	5.07	35 x 45

Cap (µF)	3000 h @ 85 ºC Catalog Part Number	Max 25 °C ESR (Ω) 120 Hz	Max 25 °C ESR (Ω) 20kHz	Max 85 °C Ripple (A_{rms}) 120 Hz	Max 85 °C Ripple (A_{rms}) 20kHz	Nominal Size (DxL) (mm)
315 Vdc (365 Vdc Surge)						
1000	SLPX102M315H9P3	0.199	0.149	3.57	4.46	35 x 50
350 Vdc (400 Vdc Surge)						
120	SLPX121M350A1P3	1.659	1.244	1.04	1.53	22 x 25
150	SLPX151M350A3P3	1.327	0.995	1.20	1.76	22 x 30
150	SLPX151M350C1P3	1.327	0.995	1.22	1.79	25 x 25
180	SLPX181M350A3P3	1.106	0.830	1.34	1.97	22 x 30
180	SLPX181M350C1P3	1.106	0.830	1.37	2.01	25 x 25
220	SLPX221M350A5P3	0.905	0.679	1.47	2.16	22 x 35
220	SLPX221M350C3P3	0.905	0.679	1.53	2.25	25 x 30
220	SLPX221M350E1P3	0.905	0.679	1.54	2.26	30 x 25
270	SLPX271M350A7P3	0.737	0.553	1.70	2.50	22 x 40
270	SLPX271M350C5P3	0.737	0.553	1.73	2.54	25 x 35
270	SLPX271M350E1P3	0.737	0.553	1.80	2.65	30 x 25
330	SLPX331M350A4P3	0.603	0.452	1.87	2.75	22 x 45
330	SLPX331M350C7P3	0.603	0.452	1.97	2.90	25 x 40
330	SLPX331M350E3P3	0.603	0.452	2.03	2.98	30 x 30
390	SLPX391M350C7P3	0.510	0.383	2.14	3.15	25 x 40
390	SLPX391M350E5P3	0.510	0.383	2.23	3.28	30 x 35
390	SLPX391M350H3P3	0.510	0.383	2.30	3.38	35 x 30
470	SLPX471M350E5P3	0.423	0.317	2.53	3.72	30 x 35
470	SLPX471M350H3P3	0.423	0.317	2.55	3.75	35 x 30
560	SLPX561M350E7P3	0.355	0.266	2.73	4.01	30 x 40
560	SLPX561M350H5P3	0.355	0.266	2.75	4.04	35 x 35
680	SLPX681M350H7P3	0.293	0.220	3.15	4.63	35 x 40
820	SLPX821M350H4P3	0.243	0.182	3.47	5.10	35 x 45
1000	SLPX102M350H9P3	0.199	0.149	3.60	5.29	35 x 50
385 Vdc (435 Vdc Surge)						
82	SLPX820M385A1P3	2.427	1.820	0.76	1.12	22 x 25
100	SLPX101M385A3P3	1.990	1.493	0.89	1.31	22 x 30
120	SLPX121M385A3P3	1.659	1.244	0.98	1.44	22 x 30
120	SLPX121M385C1P3	1.659	1.244	1.02	1.50	25 x 25
150	SLPX151M385A5P3	1.327	0.995	1.12	1.65	22 x 35
150	SLPX151M385C3P3	1.327	0.995	1.14	1.68	25 x 30
180	SLPX181M385A7P3	1.106	0.830	1.27	1.87	22 x 40
180	SLPX181M385C5P3	1.106	0.830	1.30	1.91	25 x 35
180	SLPX181M385E1P3	1.106	0.830	1.37	2.01	30 x 25
220	SLPX221M385A4P3	0.905	0.679	1.42	2.09	22 x 45
220	SLPX221M385C5P3	0.905	0.679	1.48	2.18	25 x 35
220	SLPX221M385E3P3	0.905	0.679	1.49	2.19	30 x 30
270	SLPX271M385C7P3	0.737	0.553	1.61	2.37	25 x 40
270	SLPX271M385E5P3	0.737	0.553	1.64	2.41	30 x 35
330	SLPX331M385C9P3	0.603	0.452	1.80	2.65	25 x 50
330	SLPX331M385E7P3	0.603	0.452	1.85	2.72	30 x 40
330	SLPX331M385H3P3	0.603	0.452	1.87	2.75	35 x 30
390	SLPX391M385E7P3	0.510	0.383	2.05	3.01	30 x 40

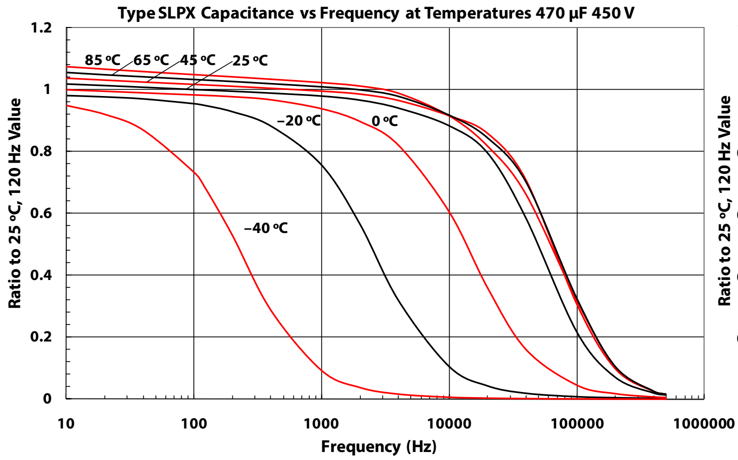
Type SLPX 85 °C Snap-In Aluminum Electrolytic

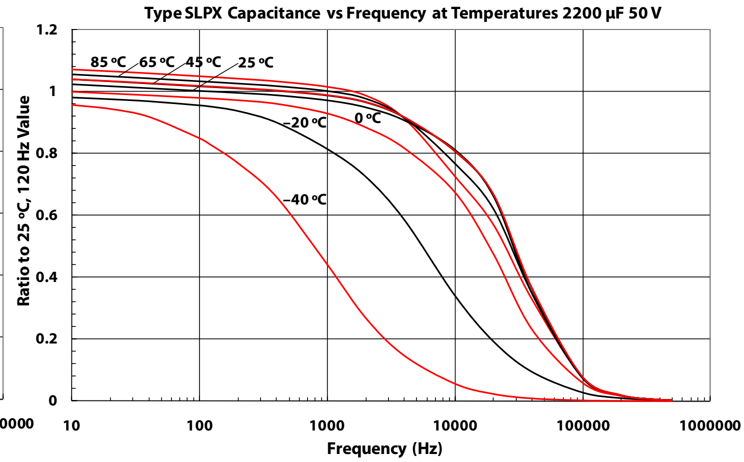
Best Value 85 °C Snap-In Type

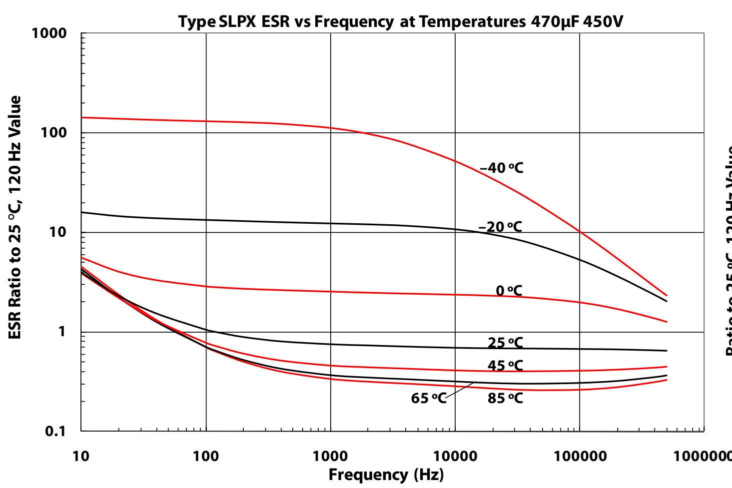
Cap µF	Catalog Part Number 3000 h @ 85 ºC	Max ESR Ω @ 25°C 120 Hz	Max ESR Ω @ 25°C 20kHz	Max Ripple (A_{rms}) max @ 85°C 120 Hz	Max Ripple (A_{rms}) max @ 85°C 20kHz	Nominal Size (DxL) (mm)
385 Vdc (435 Vdc Surge)						
390	SLPX391M385H5P3	0.510	0.383	2.07	3.04	35 x 35
470	SLPX471M385E9P3	0.423	0.317	2.26	3.32	30 x 50
470	SLPX471M385H7P3	0.423	0.317	2.26	3.32	35 x 40
560	SLPX561M385H4P3	0.355	0.266	2.59	3.81	35 x 45
680	SLPX681M385H9P3	0.293	0.220	2.80	4.12	35 x 50
400 Vdc (450 Vdc Surge)						
82	SLPX820M400A1P3	2.427	1.820	0.84	1.23	22 x 25
100	SLPX101M400A3P3	1.990	1.493	0.99	1.46	22 x 30
120	SLPX121M400C1P3	1.659	1.244	1.13	1.66	25 x 25
120	SLPX121M400A3P3	1.659	1.244	1.09	1.60	22 x 30
150	SLPX151M400A5P3	1.327	0.995	1.24	1.82	22 x 35
150	SLPX151M400C3P3	1.327	0.995	1.27	1.87	25 x 30
180	SLPX181M400A7P3	1.106	0.830	1.41	2.07	22 x 40
180	SLPX181M400C3P3	1.106	0.830	1.44	2.12	25 x 30
180	SLPX181M400E1P3	1.106	0.830	1.52	2.23	30 x 25
220	SLPX221M400A4P3	0.905	0.679	1.58	2.32	22 x 45
220	SLPX221M400C3P3	0.900	0.675	1.54	2.26	25 x 30
220	SLPX221M400C5P3	0.905	0.679	1.64	2.41	25 x 35
220	SLPX221M400E3P3	0.905	0.679	1.66	2.44	30 x 30
270	SLPX271M400C7P3	0.737	0.553	1.79	2.63	25 x 40
270	SLPX271M400E3P3	0.737	0.553	1.82	2.68	30 x 30
330	SLPX331M400E3P3	0.603	0.452	2.05	3.01	30 x 30
330	SLPX331M400H3P3	0.603	0.452	2.05	3.01	35 x 30
330	SLPX331M400C4P3	0.603	0.452	2.00	2.94	25 x 45
390	SLPX391M400E7P3	0.510	0.383	2.26	3.32	30 x 40
390	SLPX391M400H5P3	0.510	0.383	2.28	3.35	35 x 35
470	SLPX471M400E4P3	0.423	0.317	2.51	3.69	30 x 45
470	SLPX471M400H7P3	0.423	0.317	2.54	3.73	35 x 40
560	SLPX561M400H9P3	0.355	0.266	3.13	4.60	35 x 50
560	SLPX561M400H7P3	0.355	0.266	2.85	4.19	35 x 40
680	SLPX681M400H9P3	0.293	0.220	3.10	3.88	35 x 50
820	SLPX821M400H9P3	0.240	0.180	3.40	4.25	35 x 50
420 Vdc (470 Vdc Surge)						
82	SLPX820M420A1P3	2.427	1.820	0.85	1.25	22 x 25
100	SLPX101M420A3P3	1.990	1.493	0.97	1.43	22 x 30
100	SLPX101M420C1P3	1.990	1.493	0.98	1.44	25 x 25
120	SLPX121M420A3P3	1.659	1.244	1.07	1.57	22 x 30
120	SLPX121M420C1P3	1.659	1.244	1.08	1.59	25 x 25
150	SLPX151M420A5P3	1.327	0.995	1.21	1.78	22 x 35
150	SLPX151M420C3P3	1.327	0.995	1.26	1.85	25 x 30
150	SLPX151M420E1P3	1.327	0.995	1.30	1.91	30 x 25
180	SLPX181M420A7P3	1.106	0.830	1.33	1.96	22 x 40

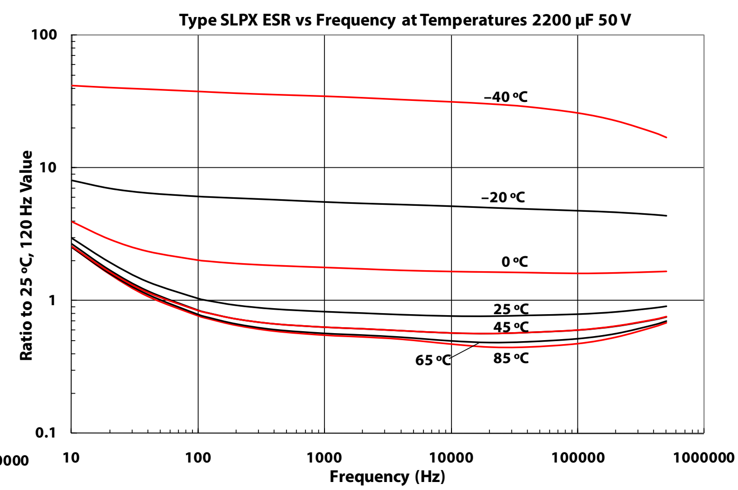
Cap µF	Catalog Part Number 3000 h @ 85 ºC	Max ESR Ω @ 25°C 120 Hz	Max ESR Ω @ 25°C 20kHz	Max Ripple (A_{rms}) max @ 85°C 120 Hz	Max Ripple (A_{rms}) max @ 85°C 20kHz	Nominal Size (DxL) (mm)
420 Vdc (470 Vdc Surge)						
180	SLPX181M420C5P3	1.106	0.830	1.42	2.09	25 x 35
180	SLPX181M420E1P3	1.106	0.830	1.48	2.18	30 x 25
220	SLPX221M420A4P3	0.905	0.679	1.55	2.28	22 x 45
220	SLPX221M420C5P3	0.905	0.679	1.58	2.32	25 x 35
220	SLPX221M420E3P3	0.905	0.679	1.65	2.43	30 x 30
270	SLPX271M420C7P3	0.737	0.553	1.74	2.56	25 x 40
270	SLPX271M420E5P3	0.737	0.553	1.90	2.79	30 x 35
270	SLPX271M420H3P3	0.737	0.553	1.94	2.85	35 x 30
330	SLPX331M420C9P3	0.603	0.452	2.20	3.23	25 x 50
330	SLPX331M420E5P3	0.603	0.452	1.98	2.91	30 x 35
330	SLPX331M420H5P3	0.603	0.452	2.17	3.19	35 x 35
390	SLPX391M420E7P3	0.510	0.383	2.22	3.26	30 x 40
390	SLPX391M420H5P3	0.510	0.383	2.27	3.34	35 x 35
470	SLPX471M420E4P3	0.423	0.317	2.50	3.68	30 x 45
470	SLPX471M420H7P3	0.423	0.317	2.61	3.84	35 x 40
560	SLPX561M420H4P3	0.355	0.266	2.95	4.34	35 x 45
450 Vdc (500 Vdc Surge)						
68	SLPX680M450A1P3	3.903	2.927	0.71	1.04	22 x 25
82	SLPX820M450A1P3	3.236	2.427	0.86	1.26	22 x 25
100	SLPX101M450C1P3	2.654	1.991	0.97	1.43	25 x 25
120	SLPX121M450A3P3	2.212	1.659	1.00	1.47	22 x 30
120	SLPX121M450C3P3	2.212	1.659	1.09	1.60	25 x 30
120	SLPX121M450E1P3	2.212	1.659	1.12	1.65	30 x 25
150	SLPX151M450A7P3	1.769	1.327	1.18	1.73	22 x 40
150	SLPX151M450C3P3	1.769	1.327	1.25	1.84	25 x 30
150	SLPX151M450E1P3	1.769	1.327	1.29	1.90	30 x 25
180	SLPX181M450E1P3	1.470	1.103	1.35	1.98	30 x 25
180	SLPX181M450A4P3	1.474	1.106	1.32	1.94	22 x 45
180	SLPX181M450C5P3	1.474	1.106	1.40	2.06	25 x 35
220	SLPX221M450C7P3	1.206	0.905	1.59	2.34	25 x 40
220	SLPX221M450E3P3	1.206	0.905	1.64	2.41	30 x 30
220	SLPX221M450H3P3	1.206	0.905	1.66	2.44	35 x 30
270	SLPX271M450C4P3	0.983	0.737	1.73	2.54	25 x 45
270	SLPX271M450E3P3	0.983	0.737	1.78	2.62	30 x 30
270	SLPX271M450E5P3	0.983	0.737	1.89	2.78	30 x 35
270	SLPX271M450H3P3	0.983	0.737	1.90	2.79	35 x 30
330	SLPX331M450H5P3	0.804	0.603	2.15	3.16	35 x 35
330	SLPX331M450E7P3	0.804	0.603	2.12	3.12	30 x 40
390	SLPX391M450E4P3	0.680	0.510	2.35	3.45	30 x 45
390	SLPX391M450H7P3	0.680	0.510	2.38	3.50	35 x 40
470	SLPX471M450H9P3	0.565	0.424	2.80	4.12	35 x 50
470	SLPX471M450H4P3	0.565	0.424	2.68	3.94	35 x 45

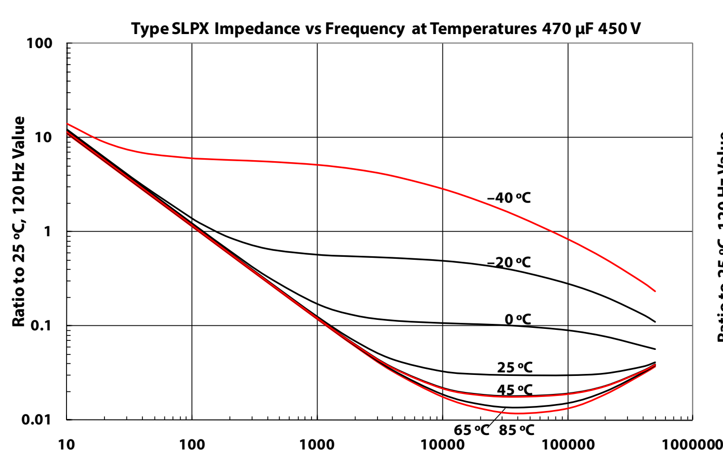
Typical Performance Curves

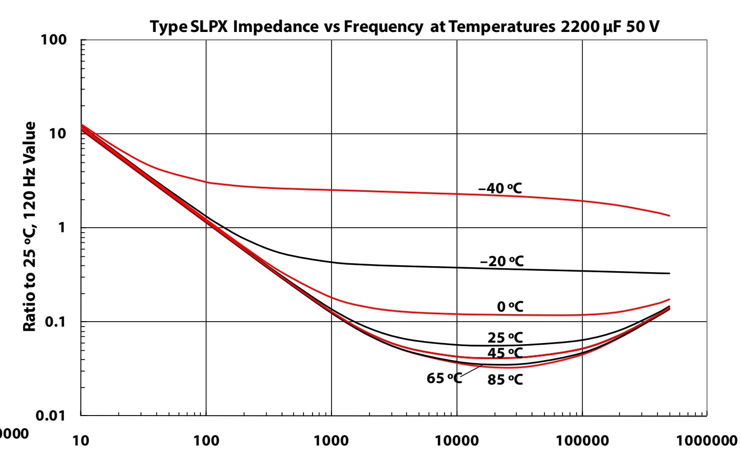












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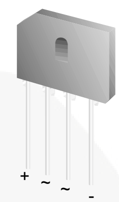
FAIRCHILD

October 2013

DFB2005 - DFB20100
Glass-Passivated Bridge Rectifiers

Features

- UL Certificate: # E258596
- Glass-Passivated Junction
- Ideal for Printed Circuit Board
- Reliable Low-Cost Construction
- Plastic Material has Underwriters Laboratory Flammability Classification 94V-0
- Surge Overload Rating to 250 A Peak
- High Case Dielectric Strength: 2000 V_{RMS}
- Isolated Voltage from Case to Lead: > 2500 V



TS-6P

Ordering Informations

Part Number	Marking	Package	Packing Method
DFB2005	DFB2005	TS-6P 4L	Rail
DFB2010	DFB2010		
DFB2020	DFB2020		
DFB2040	DFB2040		
DFB2060	DFB2060		
DFB2080	DFB2080		
DFB20100	DFB20100		

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Absolute Maximum Ratings[1]

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only. Values are at T_A = 25°C unless otherwise noted.

Symbol	Parameter	Value							Units
		DFB 2005	DFB 2010	DFB 2020	DFB 2040	DFB 2060	DFB 2080	DFB 20100	
V_{RRM}	Maximum Recurrent Peak Reverse Voltage	50	100	200	400	600	800	1000	V
V_{RMS}	Maximum RMS Voltage	35	70	140	280	420	560	700	V
V_{DC}	Maximum DC Blocking Voltage	50	100	200	400	600	800	1000	V
$I_{(AV)}$	Maximum Average Forward Rectified Current	20							A
I_{FSM}	Peak Forward Surge Current (8.3 ms Single Half-wave)	250							A
$R_{\theta JC}$	Typical Thermal Resistance[2]	4.75							°C/W
T_J	Operating Temperature Range	-55 to +150							°C
T_{STG}	Storage Temperature Range	-55 to +150							°C

Notes:

1. Single-phase, half-wave, 60 Hz, resistive or inductive load. For capacitive load, derate current by 20%.
2. Device mounted on 4 inch x 5 inch x 0.25 inch Al-plate heat sink.

Electrical Characteristics

Values are at T_A = 25°C unless otherwise specified.

Symbol	Parameter	Test condition	Value	Unit
V_F	Maximum Instantaneous Forward Voltage	10 A	1.0	V
		20 A	1.1	
I_R	Maximum DC Reverse Current at Rated DC Blocking Voltage	T_A = 25°C	10	µA
		T_A = 125°C	500	
I^2t	Rating for Fusing (t < 8.3 ms)		259	A^2s
C_J	Typical Junction Capacitance per Leg[3]		140	pF

Note:

3. Measured at 1 MHz and applied reverse bias of 4.0 V DC.

Typical Performance Characteristics

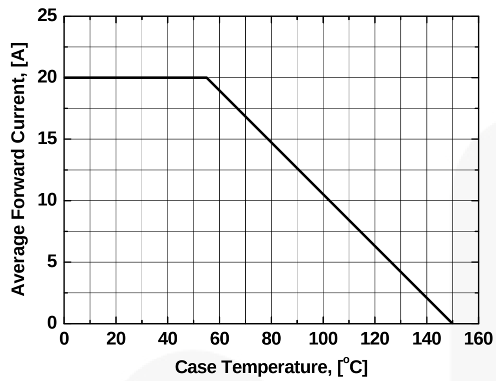


Figure 1. Maximum Derating Curve for Output Current

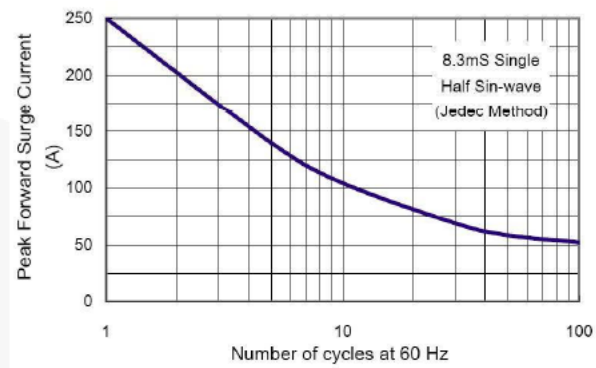


Figure 2. Maximum Forward Surge Current per Leg

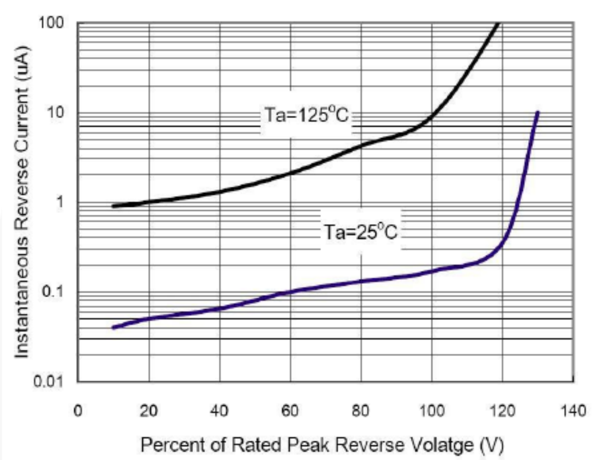


Figure 3. Typical Reverse Characteristics per Leg

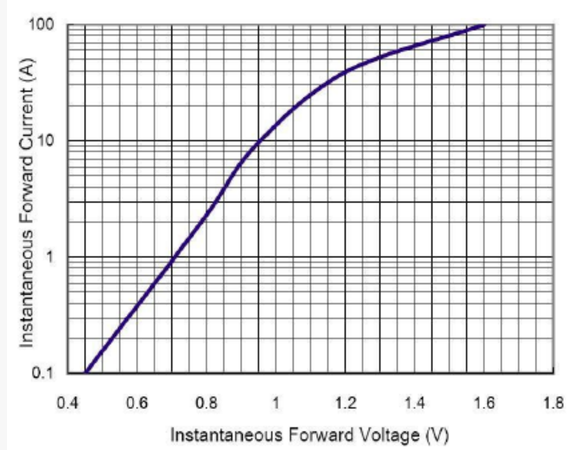


Figure 4. Typical Forward Characteristics per Leg

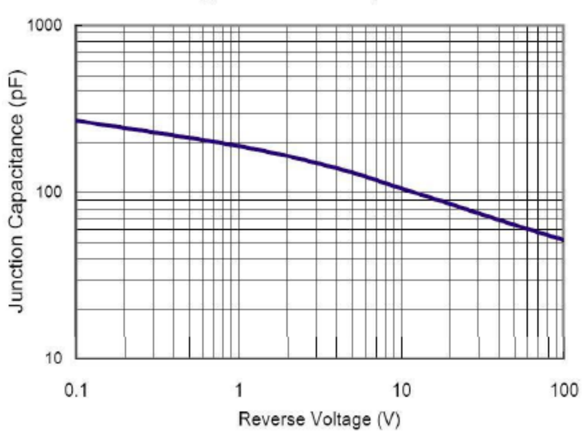
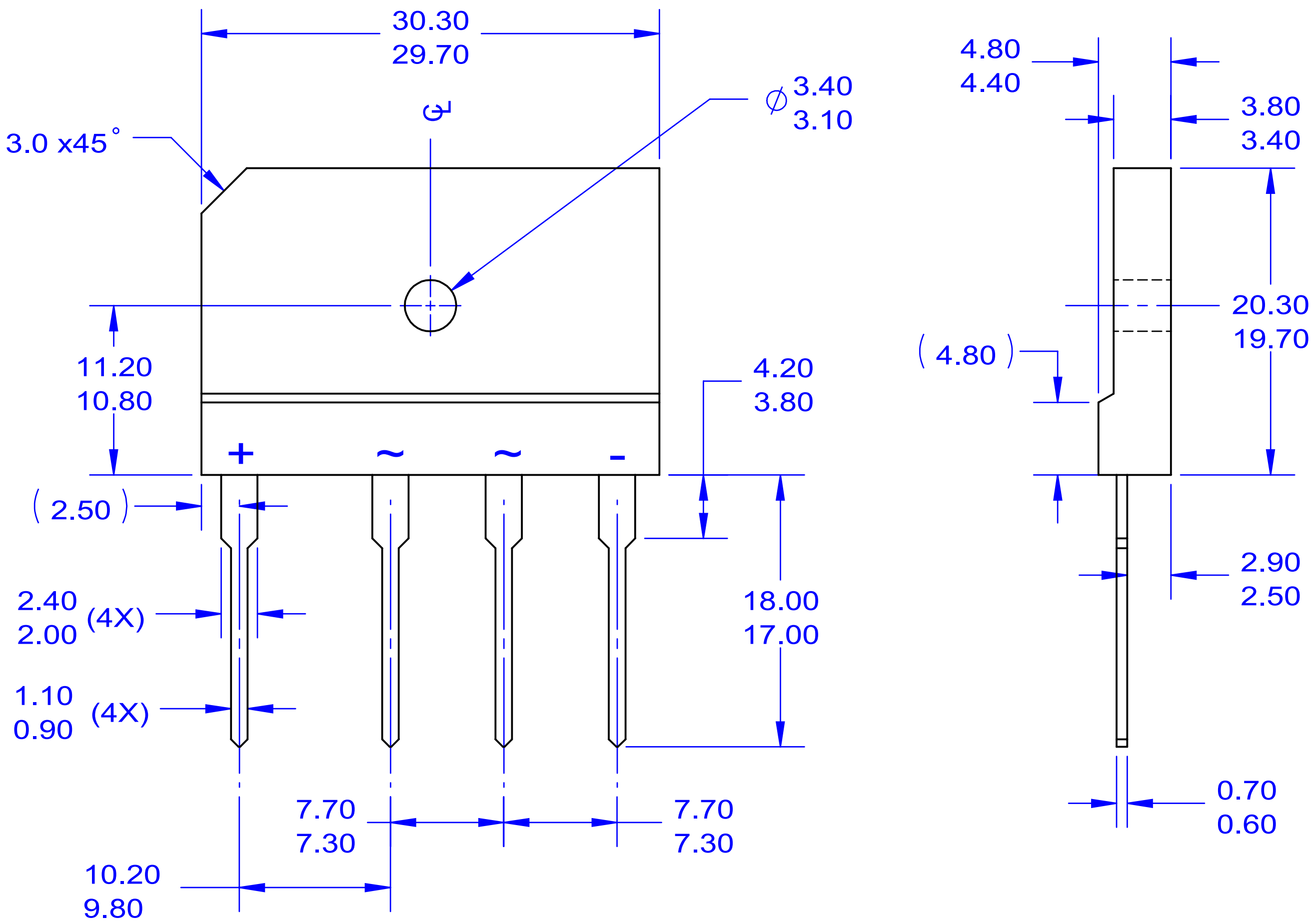


Figure 5. Typical Junction Capacitance



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December 2014

FFPF20UP40S

20 A, 400 V, Ultrafast Diode

Features

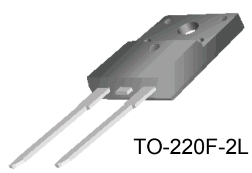
- Ultrafast Recovery t_{rr} = 50 ns (@ I_F = 20 A)
- Max Forward Voltage, V_F = 1.4 V (@ T_C = 25°C)
- Reverse Voltage, V_{RRM} = 400 V
- Avalanche Energy Rated
- RoHS Compliant

Applications

- Boost Diode in PFC and SMPS
- Freewheeling Diodes

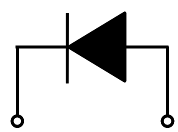
Description

The FFPF20UP40S is a ultrafast diode with low forward voltage drop. This device is intended for use as freewheeling and clamping diodes in a variety of switching power supplies and other power switching applications. It is specially suited for use in switching power supplies and industrial application.



TO-220F-2L

1. Cathode 2. Anode



1. Cathode 2. Anode

Absolute Maximum Ratings T_C = 25°C unless otherwise noted

Symbol	Parameter	Rating	Unit
V_{RRM}	Peak Repetitive Reverse Voltage	400	V
V_{RWM}	Working Peak Reverse Voltage	400	V
V_R	DC Blocking Voltage	400	V
$I_{F(AV)}$	Average Rectified Forward Current @ T_C = 102°C	20	A
I_{FSM}	Non-repetitive Peak Surge Current 60Hz Single Half-Sine Wave	200	A
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to +175	°C

Thermal Characteristics

Symbol	Parameter	Max.	Unit
$R_{\theta JC}$	Maximum Thermal Resistance, Junction to Case	2.6	°C/W

Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FFPF20UP40S	FFPF20UP40S	TO-220F-2L	Tube	N/A	N/A	50

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Electrical Characteristics T_C = 25°C unless otherwise noted

Symbol	Parameter		Min.	Typ.	Max.	Unit
V_F1	I_F = 20 A I_F = 20 A	T_C = 25°C T_C = 125°C	- -	- -	1.4 1.4	V
I_R1	V_R = 400 V V_R = 400 V	T_C = 25°C T_C = 125°C	- -	- -	50 50	μA
t_{rr} I_{rr} Q_{rr}	I_F = 20 A, di_F/dt = 200 A/μs	T_C = 25°C	- - -	29 3.3 47	50 5.5 138	ns A nC
W_{AVL}	Avalanche Energy (L = 40 mH)		1	-	-	mJ

Notes:
1: Pulse: Test Pulse width = 300μs, Duty Cycle = 2%

Test Circuit and Waveforms

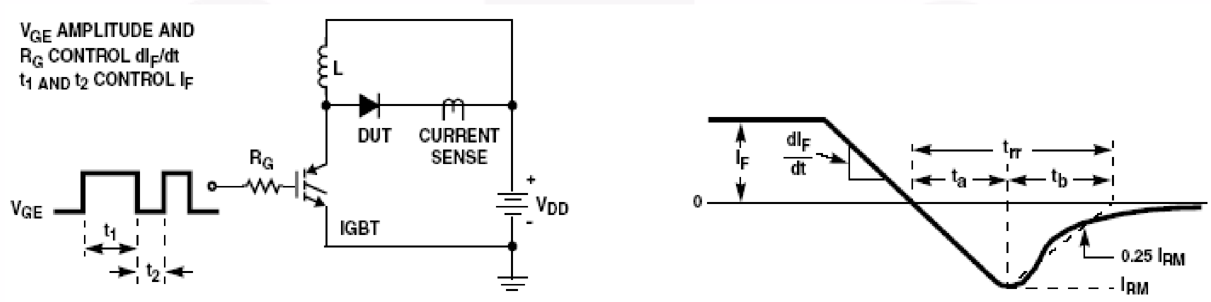


Figure 1. Diode Reverse Recovery Test Circuit & Waveform

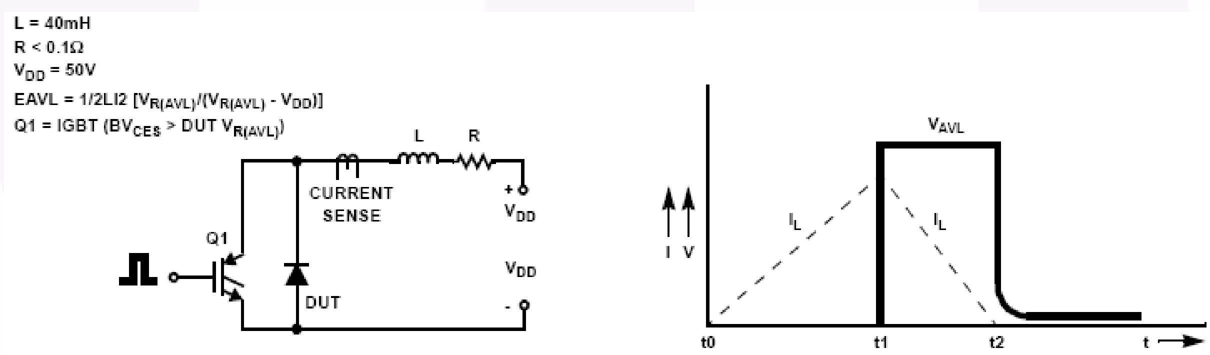


Figure 2. Unclamped Inductive Switching Test Circuit & Waveform

Typical Performance Characteristics

Figure 3. Typical Forward Voltage Drop vs. Forward Current

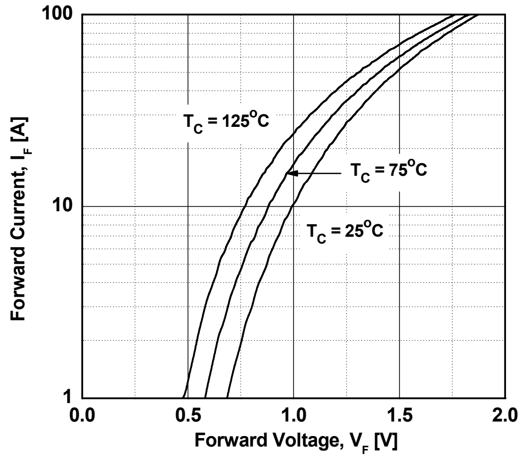


Figure 4. Typical Reverse Current vs. Reverse Voltage

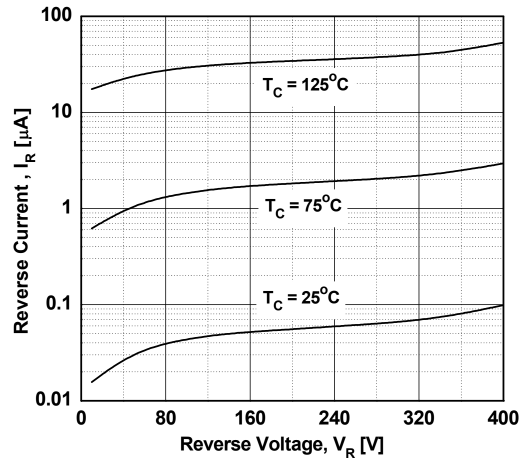


Figure 5. Typical Junction Capacitance

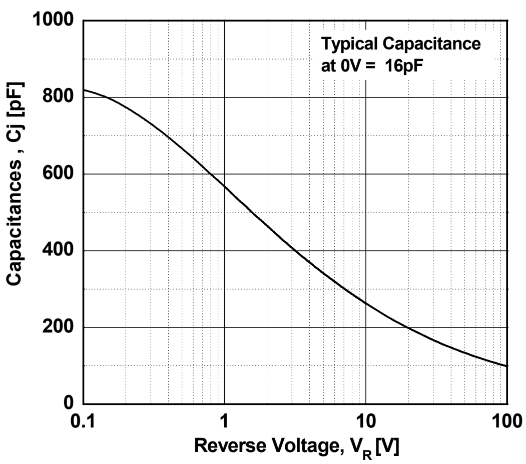


Figure 6. Typical Reverse Recovery Time vs. di$_F$/dt

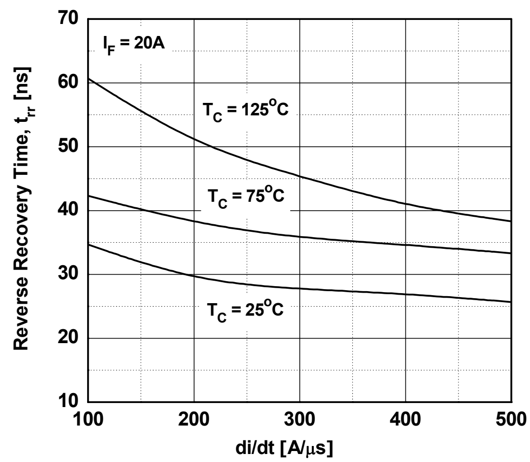


Figure 7. Typical Reverse Recovery Current vs. di$_F$/dt

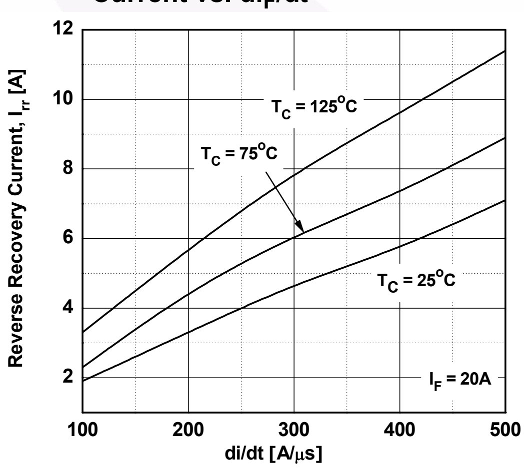
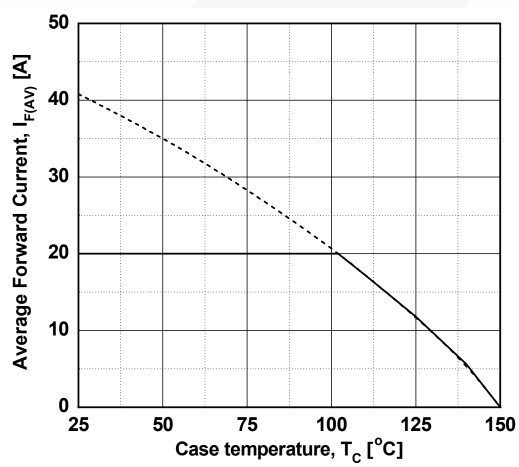


Figure 8. Forward Current Derating Curve



Mechanical Dimensions

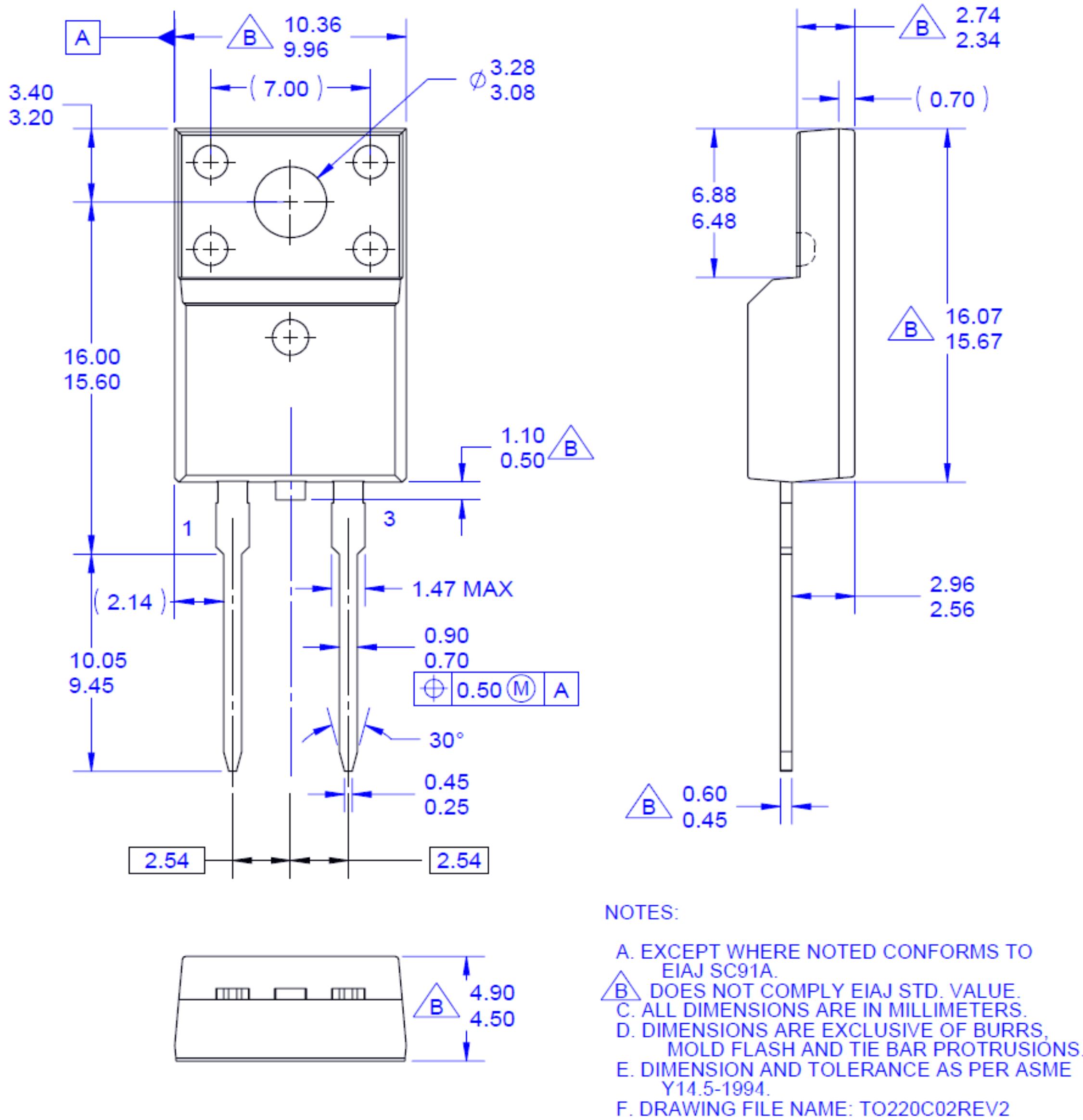


Figure 9. TO-220F 2L - 2LD; TO220; MOLDED; FULL PACK

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Datasheet Identification	Product Status	Definition
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Preliminary	First Production	Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
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