

Introduction

MPS is committed to providing users with a variety of simulation solutions, including SIMPLIS models, SPICE models, DC/DC converter design models, and <u>Virtual Bench Pro</u>.

The easy-to-use Design Assistant is the most popular tool provided by MPS, and its demand continues to grow each year. Figure 1 shows the annual growth of how often our Design Assistant is requested and utilized.



Figure 1: Design Assistant Proportion Analysis

In particular, the Design Assistant for <u>AC/DC products</u> is popular because of its wide range of products and comprehensive design functions.

To simplify the Design Assistant, MPS officially launched new Design Assistant files for AC/DC products in May 2021. These new files included functional enhancements, interface updates, and QA testing. Figure 2 shows how the <u>AC/DC Design Assistant</u> was downloaded more often on a month-by-month basis as a result of this update.



Figure 2: AC/DC Design Assistant Monthly Downloads

This article will explore the advantages of the <u>AC/DC Design Assistant</u>.

Improved Design Assistant Interface

The revamped Design Assistant adopts a similar interface style to the MPS website, creating a harmonious and unified user experience. The text specifications are uniform for parameters such as input, output, and annotation. Figure 3 shows the new Design Assistant interface.





1. System Spec				[
Input Spec				
Minimum Line Voltage	Vac_min	85	v	
Maximum Line Voltage	Vac_max	265	V	
Line Voltage Frequency	fline	<u>50</u>	Hz	
Output Spec	Vo(n)		loMax(n)	
Output1	24	v	1	
Output2	0	V	0	
Output3	0	V	0	
Output Power	24	W		
Estimated Efficiency	η	0.82		
Input Power	Pin	29.27	W	
Switching Frequency	fs	55	kHz	
Capacitance connected to FSET pin	CESET	470	pF	

Figure 3: The New Design Assistant Interface

The Instruction page makes it easy for users to get started by providing clear guidance and assistance, in addition to annotating the design steps for each page. For users who want more details about the design process, the Detailed Instruction page covers the design steps of each key parameter.

Figure 4 shows the Design Assistant guide interface.

Power Solution Experts	Version 1.0 Date: 2021 March 31st <u>Legal Notice</u>
This spreadsheet is used for Fixed Frequency Flyback Controller Design HFC0300, which needs further bench verification.	based on
01_Circuit Design	
Circuit Design includes 01_Basic Parameters;	
2 Input required specs in blue font, like Vin_ac_min 85 V	
3 Step by step, get recommended results , like Pin 29.27 W	
based on input;	
4 take the note besides Vro=N x (Vo+Vf), Typically, 85-135 V as reference to	
check the data validity;	
Next Step	

Figure 4: Design Assistant Guide Interface

The current <u>AC/DC Design Assistant</u> covers products such as flyback applications, power factor correction (PFC) applications, LLC applications, and all-in-one applications. Most tools include the external circuit design, as well as transformer design. The design files support one-click printing, which allows users to obtain a preliminary design and quickly validate their design performance in conjunction with other MPS simulation models. As a result, MPS has effectively shortened and simplified the development process.

Design Assistant Set-Up

To set up Design Assistant, follow the steps below.

1. Navigate to the <u>Products</u> page on the MPS website, and filter through the AC/DC product line to select the relevant product.



2. On the product page, click "XLSX" under the "Design Resources" tab to download the tool without having to log in.

Consider the <u>MPX2001</u>, an all-in-one flyback controller that integrates a primary driving circuit, secondary controller, and synchronous rectification driver. This article uses the <u>MPX2001</u> to showcase the Design Assistant and verify its functionality using the SIMPLIS model in SR mode.

Figure 5 shows the Design Assistant download interface on the MPX2001's detail page.

MPX2	2001	All-in-one F and Second Capacitive I	Flyback Controller w ary, Synchronous Re solation	ith Integrated Primary ctification Driver with		Active	کر Datasheet
Overview	Evaluatio	n Tools	Design Resource	es Technical Forum	Quality		
	Desi	gn Re	sources	5			
	Refer	ence M	aterials				
	Туре			Title			
	Article		E	Primary-Side vs. Second	lary-Side Regulation	ı	
	Design	Tools					
	MPSr	mart Mod	el	Model of this part to sime	ulate in MPSmart So	ftware	
	📔 MPSr	mart Simu	lation	Software to simulate MP	S ICs		
	📔 XLSX			All-in-on Flyback control	ler Design Tool for M	MPX2001	

Figure 5: MPX2001 Design Assistant Download Interface

- Download and save the <u>MPX2001</u> Design Assistant and the <u>MPX2001</u> SIMPLIS model, which are both under the "Design Tools" tab.
- 4. Enter the basic parameters based on the prompts in Design Assistant and modify the recommended values in the SIMPLIS model.

Figure 6 shows an example regarding the <u>AC/DC Design Assistant</u>'s input capacitor parameter. The input capacitor value is determined using the input power supply and the input capacitor power coefficient (K_InputCAP).



Figure 6: Input Capacitor of the AC/DC Design Assistant

Figure 7 shows an example of the <u>AC/DC Design Assistant</u> regarding transformers. Depending on key parameters — such as the primary-side equivalent output voltage (V_{RO}) and current ripple coefficient (K_P) — the transformer ratio, primary-side MOSFET tube pressure resistance, and primary inductance (L_M) can all be determined.





Reflected output voltage	Vro	<u>100</u>	V	J Define Ideal Transformer	>
Transformer Turns Ratio Primary main MOSFET voltage Secondary 1 rectifier voltage Secondary 2 rectifier voltage	Nps1 Vp_MOSFET VSR Vd2	8.264 594.185 85.941 0.000	V V V	Configuration Define windings # Primaries 2 Select winding Sec. 1: 0.12 # Secondaries 1 Ratio to primary 1 121m	
4. Primary Lm, Ipeak and Sense Resistor				Inductance and coupling Primary 1 Annual Annua	
				inductance 4700 coupling	
Ratio of ripple current and peak value Primary Inductance Current sense resistance	Kp Lm Rsense	<u>0.7</u> 473.976 0.202	uH Ω	inductance 47.00 coupling I Inter-primary I Primary-secondary I coupling I coupling	
Ratio of ripple current and peak value Trimary Inductance Turrent sense resistance Tomer hoss on Sense Resistor Trimary maximum root meen square current	Kp Lm Rsense Psense Ipri rms	<u>0.7</u> 473.976 0.202 0.211 1.023	uH Ω W A	Inductance 4700 coupling 1 Inter-primary 1 Primary-secondary 1 Coupling 0k Cancel H	elp

Figure 7: Transformer of the AC/DC Design Assistant

The output capacitor is selected based on the output voltage ripple (see Figure 8). Other designs, such as the RCD snubber circuit, compensation network, and EBO resistors are selected in a similar manner.

SR of output 1 cap Dutput 1 filter capacitance AC rms current in output 1 capacitor	ESR1 Co1 Icap1_rms	0.01 421.437 5.678	Ω uF A	L. TY2					, ILC
Sutput 2 voltage ripple	∠\ V2	<u>0</u>	V	\$1 2.2n	5.1	COUT1	COUT2	20m	2.
SR of output 2 cap	ESR2	<u>0</u>	Ω	C3	R13			R23	
Jutput 2 filter capacitance	Co2	-	иF	Q1				P1	I
Dutput 2 filter capacitance AC rms current in output 2 capacitor	Co2 Icap2_rms	0.000	uF A	Q1 IRF540	10k	4		t	R1 20m

Figure 8: Output Capacitor of the AC/DC Design Assistant

Figure 9 shows the <u>MPX2001</u> simulation results created by the Design Assistant using the SIMPLIS software. The user can see the waveforms of the primary and secondary voltages, currents, and other key nodes based on the design.



Figure 9: MPX2001 SIMPLIS Model Simulation Results

Once the main circuit is determined, the user enters the B_{MAX} and J_{MAX} values on the Transformer Design page. These values can be selected by either using the recommended core AP, or manually entering the transformer parameters to obtain specifications (e.g. the number of turns and diameter).

Figure 10 shows the Transformer Design page of the <u>AC/DC Design Assistant</u>.



Power Solution Exper	ts						
1. Determine the Transfor	mer Core	and Tur	ns				
the maximum flux density	Bmax	0.28	т	Typically 0.1-0.3T			
current density Jmax		700	Alcm ²	Typically,400-700A/cm2			
requiered AP value		*****	mm ⁴				
requiered AF value							
2. Core Selection							
ି Create Custom Co	re			Ise Standard Core € 10 × 10 × 10 × 10 × 10 × 10 × 10 × 10			
	-						
3. Create Custom Core					3. Use Standard Core		
transformer core area Ae	119	mm²	1				л
					select the core shape	EFD	1
winding area Aw	60.4	۳m²				G0!	
							-
transformer core AP	7187.6	mm`]		the selected core	EFD25	*
primary winding	33	Turns	1		effective length Le	57	
······					winding area Aw	67.89	
output1 winding	4	Turns			AP of the selected cor	3937.62	
		_					
output2 winding	0	Turns			primary winding	66	Tur
auxiliaru winding	4	Turne			output i winding	8	Tur
auxinary minuling		ruins	1		auxiliaru winding	9	Tur
4. Determine the diamete	r of the c	oil	1		4. Determine the diam	eter of the	coil
skin depth	0.29	mm	Coil dia	meter is suggested no larger than 2 times of skin d	skin depth	0.29	m

Figure 10: AC/DC Design Assistant Transformer Design Page

Conclusion

MPS' improved Design Assistant provides strategic advantages that shorten the development process. This article explored <u>AC/DC Design Assistant</u> with the <u>MPX2001</u>, and verified its set-up process and functionality. Moreover, the MPS website includes Design Assistant files for other circuits, such as LLC applications and LR design.