

Using the Flexible Transformer LTspice models

UG001 // TOBY KANGAS

1 Introduction

The WE-FLEX, WE-FLEX HV and WE-FLEX+ series of transformers are designed to be used in a wide variety of applications, by connecting the identical 6 windings in a configuration on the board which produces the desired transformer variant. Combined, these three series account for 65 transformers, which facilitate more than 1000 possible transformer variants. Parts without an air gap are especially designed for buck-derived topologies like forward or push-pull converters, whereas the gapped parts are suited for flyback converters. The high flexibility of the transformers allows developers to realize their own transformers without having to resort to a customer-specific transformer.

2 Types of Models

2.1. Configured with Single Output

The single-output LTspice model is meant to be used when the transformer is configured to have only a single input and single output. This is even if the transformer utilizes all 6 windings, but is connected in such a manner equivalent to a single input and single output. The model parameters must be set to identify the winding configurations, and it will simulate much faster than the multiple-output model.

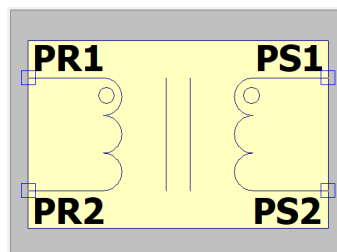


Figure 1: Single-Output Model

2.2. Configured with Multiple Outputs

This model features all 6 windings, which must be connected on the schematic in the desired configuration. This model is more flexible than the single output model and allows for multiple outputs, but the simulation speed is much slower, as 6 windings must be simulated rather than the 2 equivalent windings that are in the single-output model.

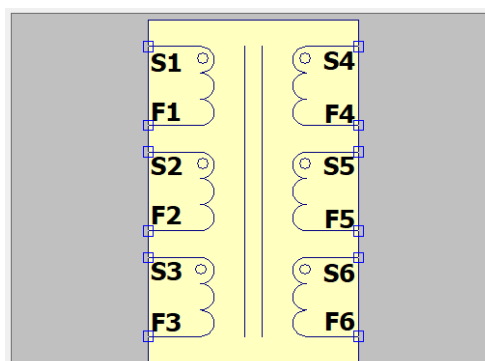


Figure 2: Multiple-Output Model

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3 How to Use the Models

3.1. Insert the Symbol

- If installing the models yourself, save the *.lib files in the user folder ... \Documents\LTspiceXVII\lib\sub.
- Save the *.asy files in the user folder ... \Documents\LTspiceXVII\lib\sym or a subfolder thereof. If LTspice is open, it must be closed and re-opened to view the new models in the component directory.
- For the single-output model, add the symbol WE-FLEX, WE-FLEX-HV or WE-FLEX+ to the schematic.
- For the multiple-output model, add the symbol WE-FLEX_MultiOut, WE-FLEX-HV_MultiOut, or WE-FLEX+_MultiOut to the schematic.

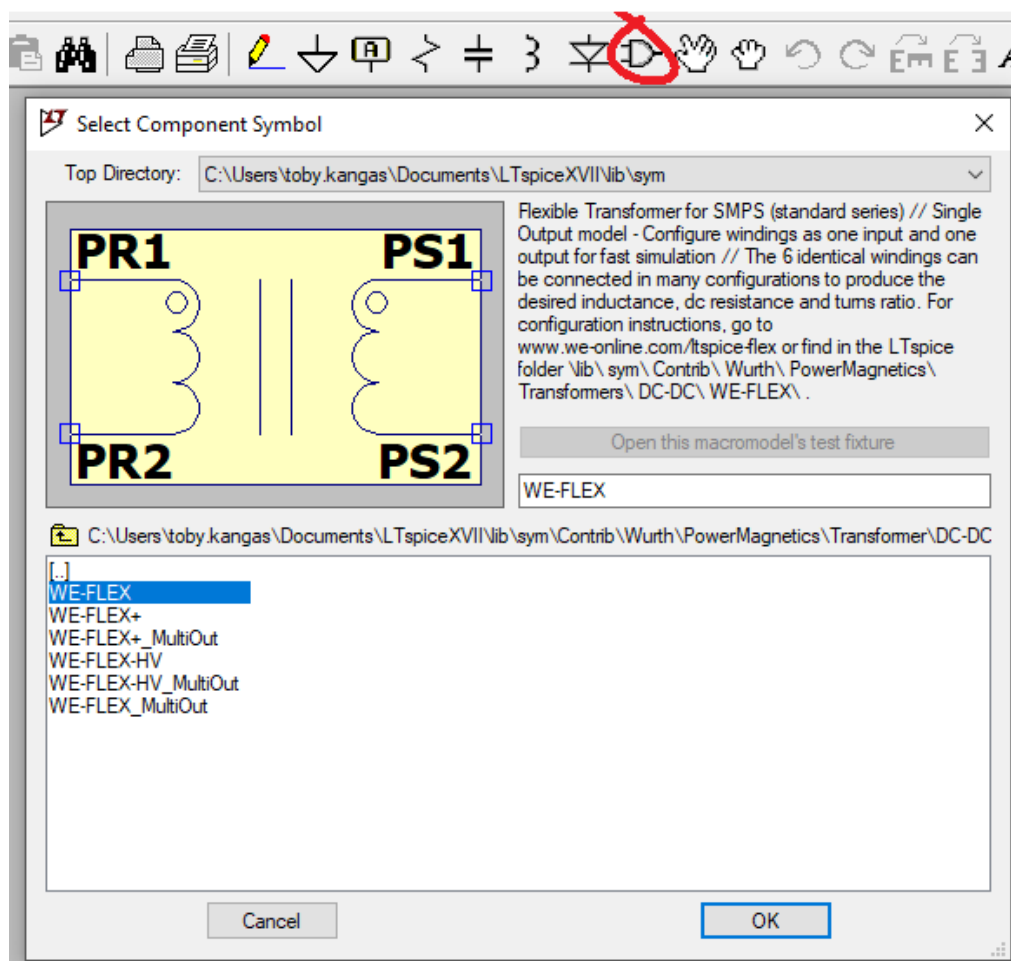


Figure 3: Insert the WE-FLEX symbol

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3.2. Select Part Number

Right-click on the symbol to open the Component Attribute Editor. Choose the correct part number by double-clicking or triple-clicking on the SpiceModel value.

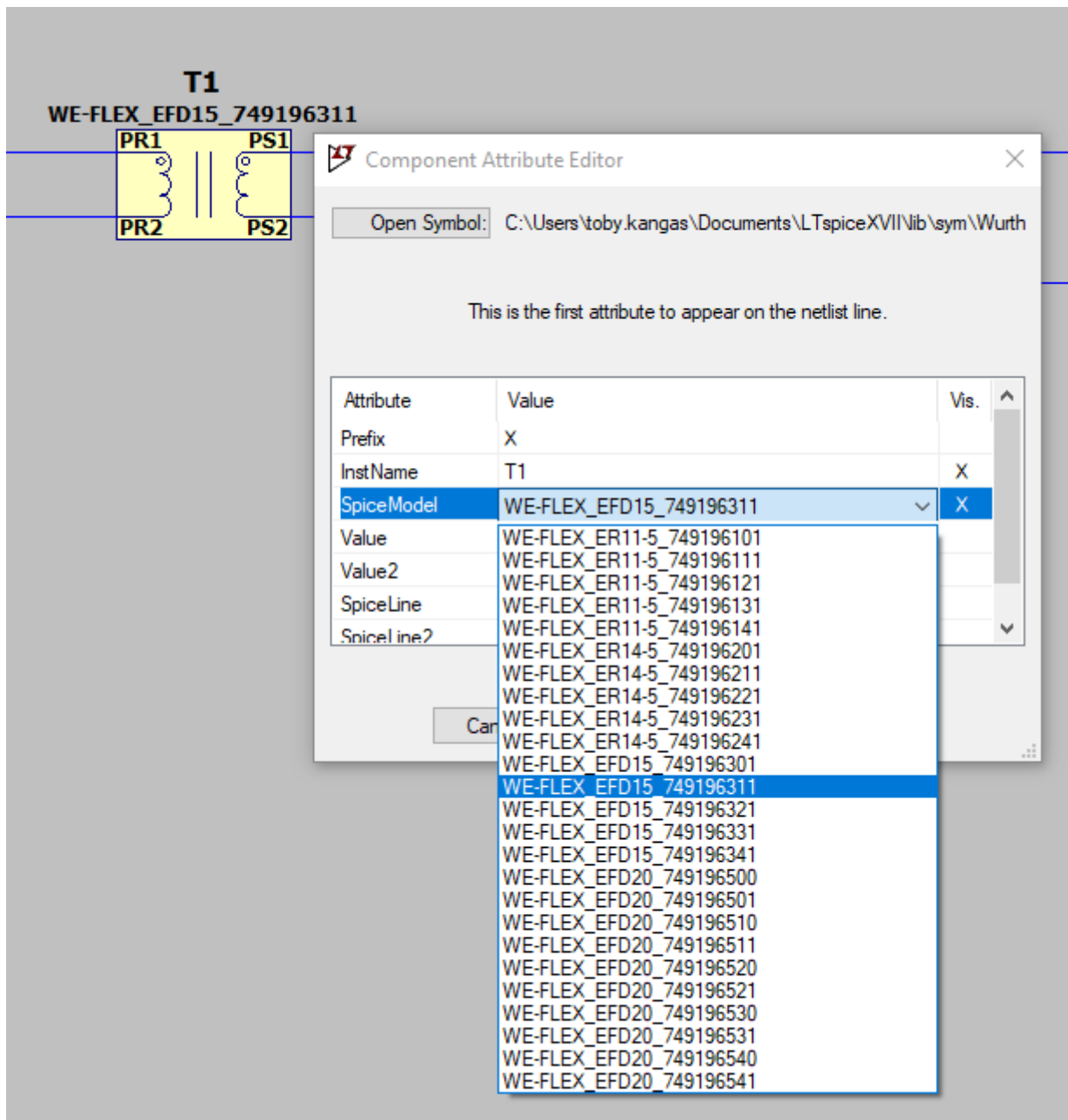


Figure 4: Select the Part Number

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3.3. Configure the Model – Single-Output Model

The FLEX series transformers are designed with six identical windings, such that the windings can be connected in many combinations of series or parallel configurations to achieve the desired turns ratio, inductance and current-carrying capabilities. Eleven possible winding configurations are given for each side of the transformer.

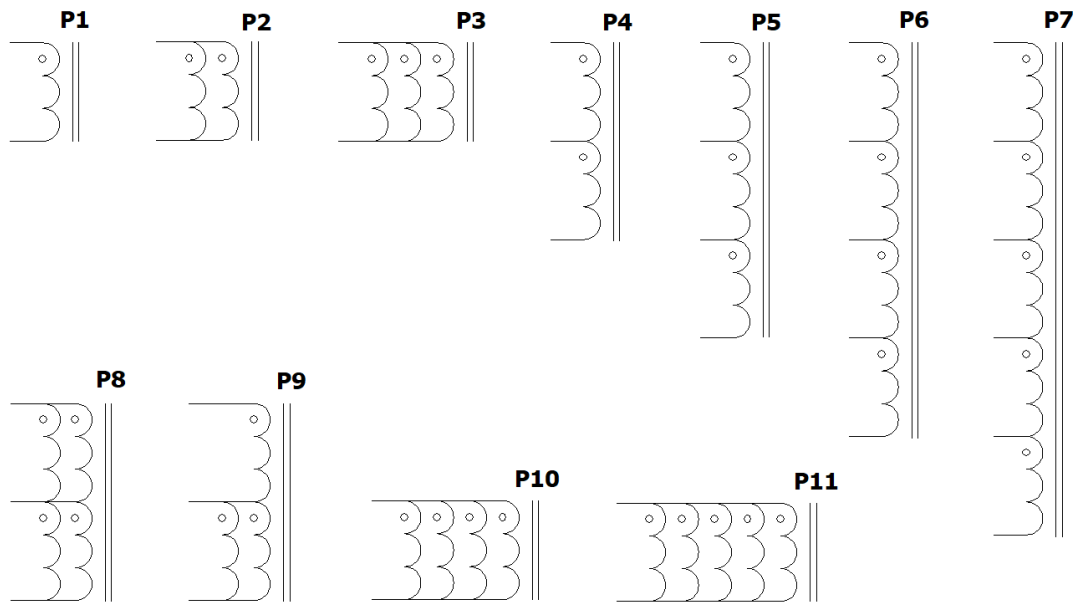


Figure 5: Primary-side Configurations

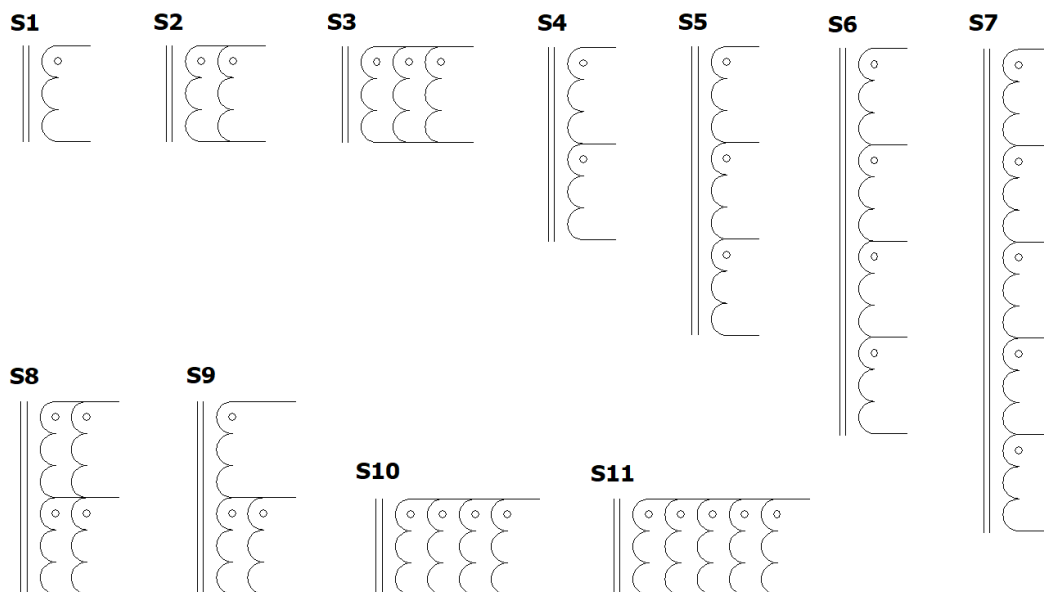


Figure 6: Secondary-side Configurations

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Following is an example using part number 749196311 configured with three windings connected in parallel for the primary and three windings connected in series for the secondary. This configuration gives a turns ratio of 1:3, and maintains the base inductance value on the primary side.

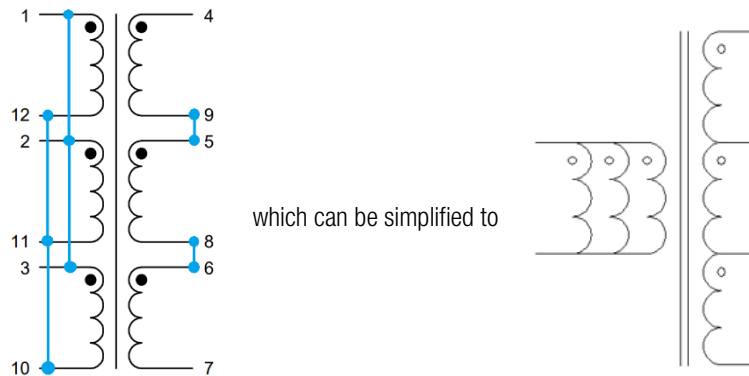


Figure 7: Example Configuration

This example uses a primary-side configuration of P3 and a secondary-side configuration of S5.

Configure the model with an operating temperature between 25°C and 100°C and the appropriate winding configuration number for the primary and secondary side. (Double-click to edit the value.)

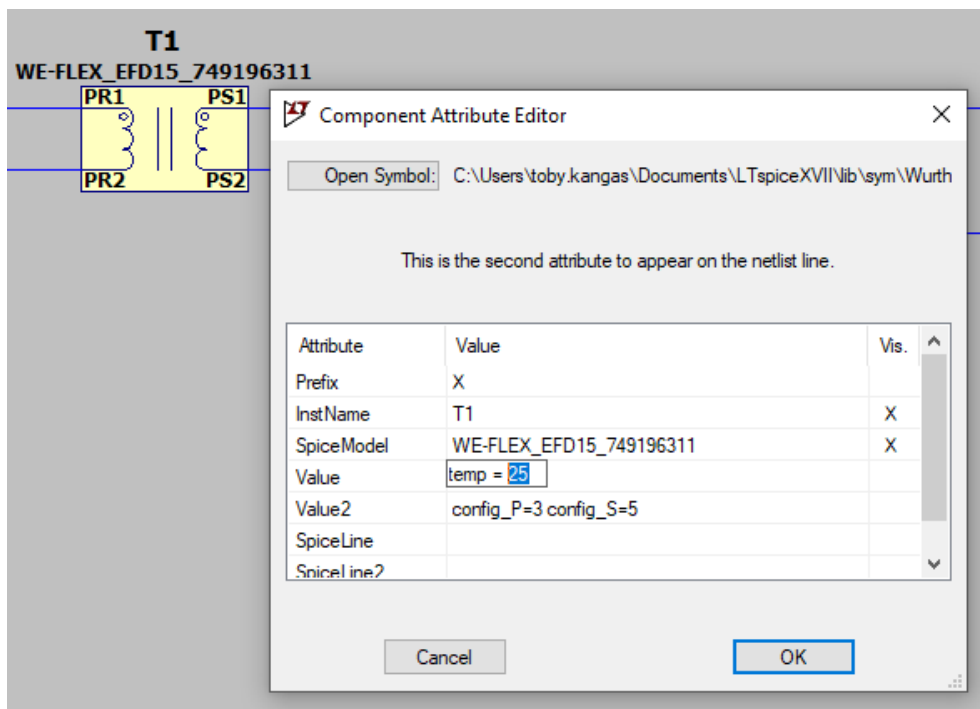


Figure 8: Configure in Component Attribute Editor

Click "OK". The transformer model is configured and ready to simulate.

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3.4. Configure the Model – Multiple-Output Model

Unlike the Single-Output model which uses special input parameters to define the configuration, the Multiple-Output model must be connected on the schematic to the desired configuration. The example below features three windings connected in parallel for the primary, and two secondary outputs.

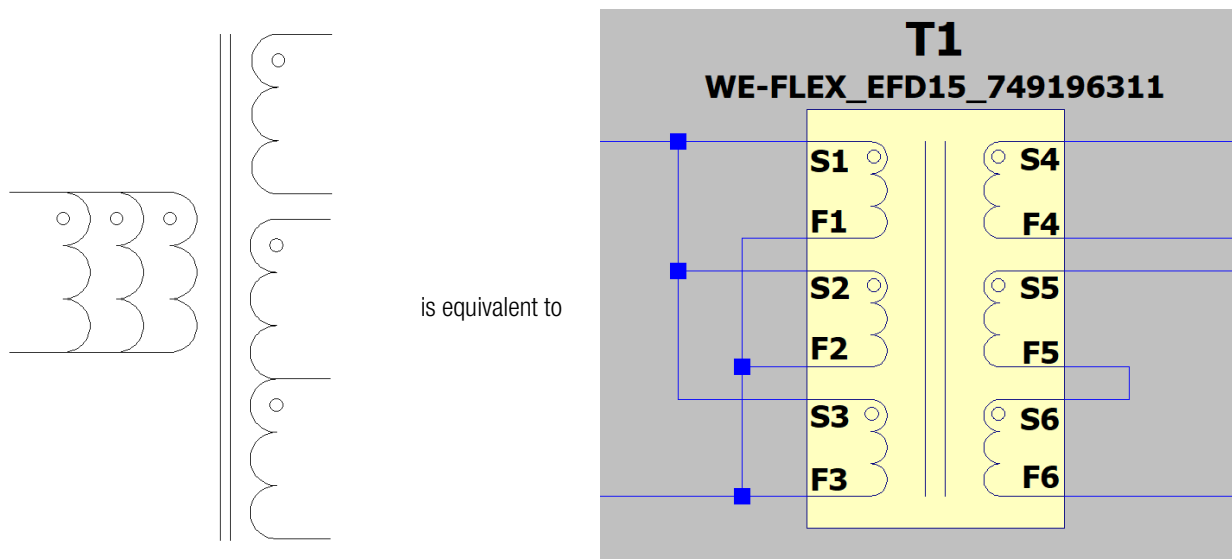


Figure 9: Example Configuration

Like the Single-Output model, the Multiple-Output model can also be configured with an operating temperature between 25°C and 100°C. (Double-click to edit the value.)

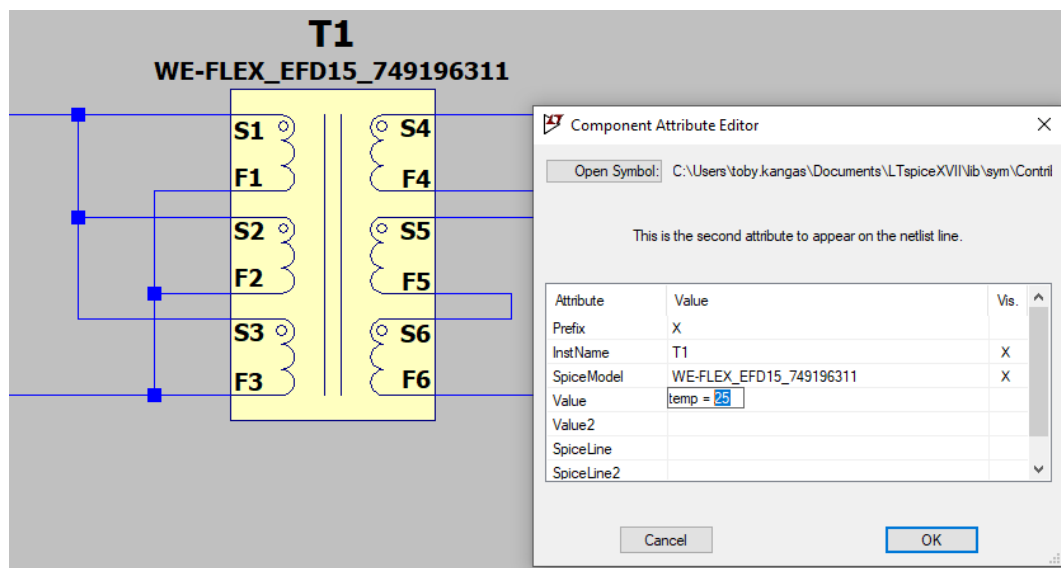


Figure 10: Configure in Component Attribute Editor

Click "OK". The transformer model is configured and ready to simulate.

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4 Overview of Series

An overview of the flexible transformer series is found in the tables below.

WE-FLEX				WE-FLEX HV			
Size	PN	Inductance (base) [μ H]	Gap	Size	PN	Inductance (base) [μ H]	Gap
ER11.5	749196101	198.6	no	ER11.5	749196108	224.6	no
ER11.5	749196111	27.4	yes	ER11.5	749196118	27.4	yes
ER11.5	749196121	14.7	yes	ER11.5	749196128	14.7	yes
ER11.5	749196131	10.9	yes	ER11.5	749196138	10.9	yes
ER11.5	749196141	8.5	yes	ER11.5	749196148	8.5	yes
ER14.5	749196201	140	no	ER14.5	749196208	140	no
ER14.5	749196211	21.6	yes	ER14.5	749196218	21.6	yes
ER14.5	749196221	11.6	yes	ER14.5	749196228	11.6	yes
ER14.5	749196231	8.3	yes	ER14.5	749196238	8.3	yes
ER14.5	749196241	6.6	yes	ER14.5	749196248	6.6	yes
EFD15	749196301	153.8	no	EFD15	749196308	153.8	no
EFD15	749196311	23.3	yes	EFD15	749196318	23.3	yes
EFD15	749196321	14.2	yes	EFD15	749196328	14.2	yes
EFD15	749196331	9.3	yes	EFD15	749196338	9.3	yes
EFD15	749196341	7.9	yes	EFD15	749196348	7.9	yes
EFD20	749196500	87.1	no	EFD20	749196507	87.1	no
EFD20	749196501	196	no	EFD20	749196508	196	no
EFD20	749196510	9.9	yes	EFD20	749196517	9.9	yes
EFD20	749196511	22.3	yes	EFD20	749196518	22.3	yes
EFD20	749196520	5.3	yes	EFD20	749196527	5.3	yes
EFD20	749196521	12	yes	EFD20	749196528	12	yes
EFD20	749196530	4.3	yes	EFD20	749196537	4.3	yes
EFD20	749196531	9.7	yes	EFD20	749196538	9.7	yes
EFD20	749196540	3.4	yes	EFD20	749196547	3.4	yes
EFD20	749196541	7.6	yes	EFD20	749196548	7.6	yes

WE-FLEX+			
Size	PN	Inductance (base) [μ H]	Gap
ETD29	749197101	195	no
ETD29	749197111	75.1	yes
ETD29	749197121	46.3	yes
ETD29	749197131	24.3	yes
ETD29	749197141	15	yes
ETD34	749197201	374.4	no
ETD34	749197211	113.8	yes
ETD34	749197221	69.4	yes
ETD34	749197231	36.1	yes
ETD34	749197241	22	yes
ETD39	749197301	326.7	no
ETD39	749197311	128.5	yes
ETD39	749197321	77.3	yes
ETD39	749197331	39.4	yes
ETD39	749197341	23.7	Yes

Figure 11: Overview of Flexible Transformer Series

Additional information can be found at [www.we-online.com/catalog/flexible transformers for smeps](http://www.we-online.com/catalog/flexible_transformers_for_smeps)

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