

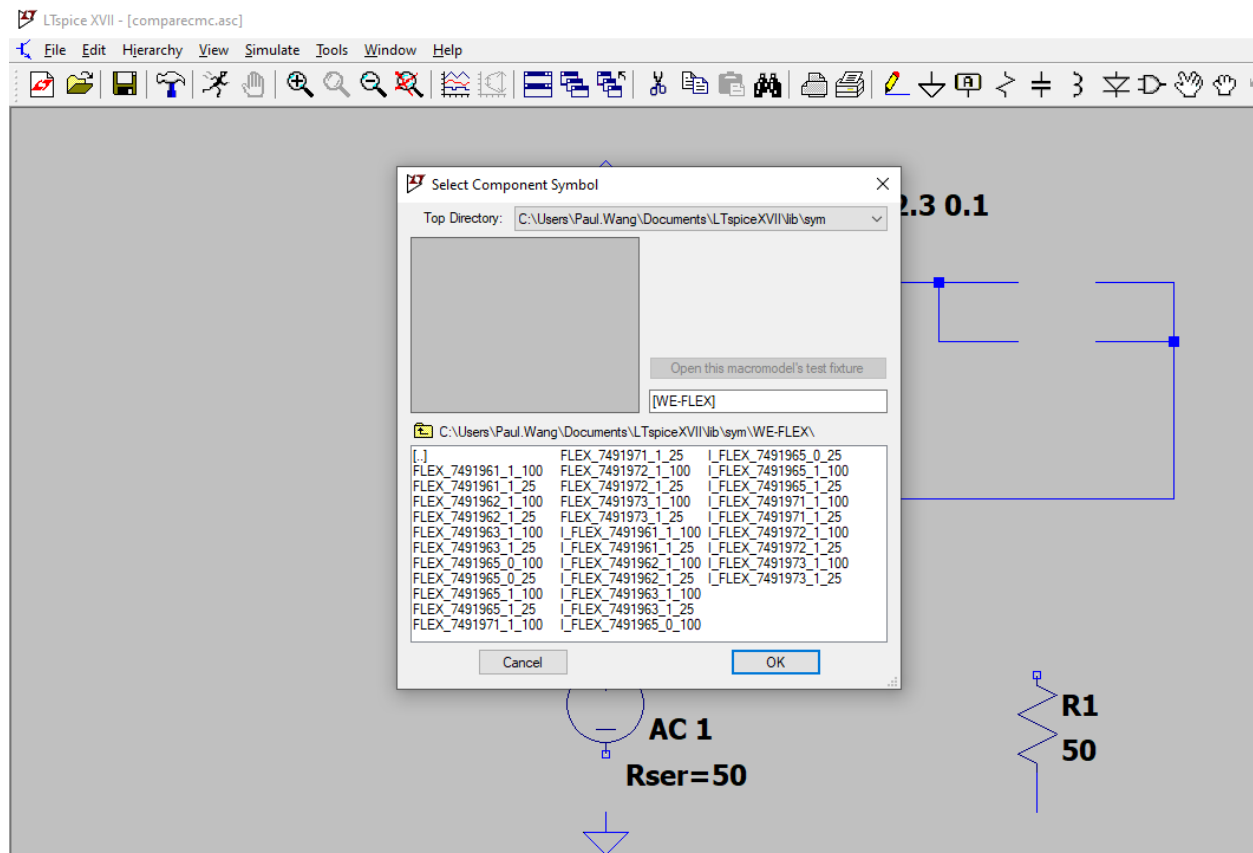
How to simulate a transformer using parameters

We can find the Online Model Package on www.we-online.com/LTspice.

It contains all necessary models and model files for the use of the WE-FLEX transformers in LT spice.

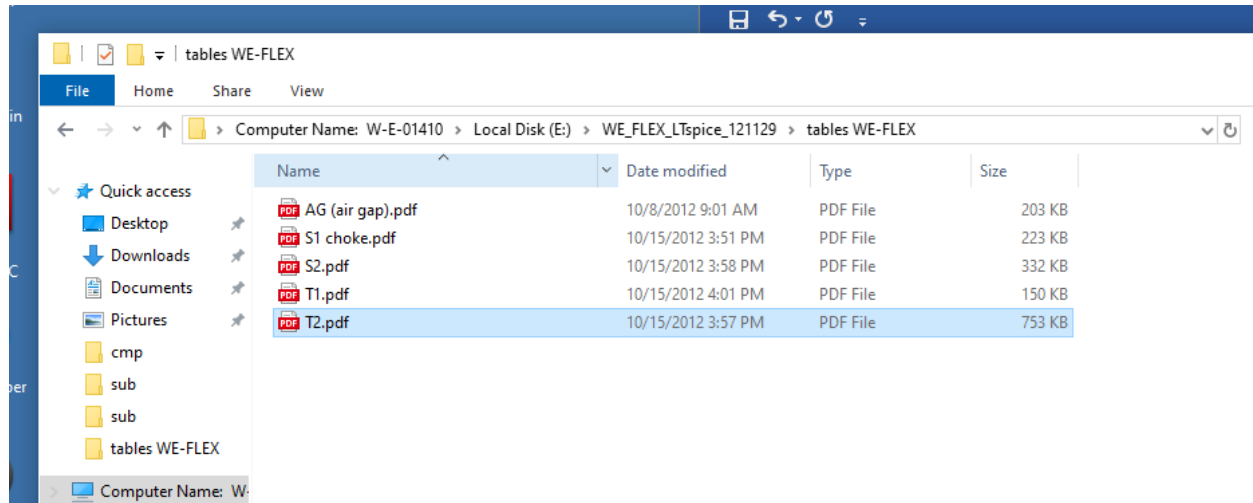
A) Install the files from online

We need to install the files in the library of LT spice where our parts stored, then we can click Edit/Component, find the directory of WE-FLEX we just stored and choose symbol we need to simulate, we can see that all kinds of transformers and inductors are in this directory.



Imaginary1. Install package in LT spice

Well, there are also others files (tables) provided from the online model package, Such as AG、S1、S2、T1 and T2. Among them, S1 and T1 are dates about inductors, and S2 and T2 are dates about transformers, AG corresponds the value of air gap. We can then search dates we need in those files and those files can be stored anywhere on the hard disk, where it suits you.



Imaginary2. 5 tables provided from online model package

B) Parameters configuration

a) AG

First of all, we should configure parameter of AG. We need to search value corresponding in AG (air gap).pdf according to part number. As showing in below picture, we have 40 kinds of versions of transformers in total.

Air Gap (AG) parameter range of WE-FLEX and WE-FLEX+ transformer								
size	ER11	ER14,5	EFD15	EFD20	EFD20	ETD29	ETD34	ETD39
without air gap	749196101	749196201	749196301	749196500	749196501	749197101	749197201	749197301
AG	772	1173	952	1837	1836	2277	2711	3710
series 1	749196111	749196211	749196311	749196510	749196511	749197111	749197211	749197311
AG	7452	9838	10375	24156	24129	12829	12844	12538
series 2	749196121	749196221	749196321	749196520	749196521	749197121	749197221	749197321
AG	14335	18662	17497	46018	45726	21777	22165	22178
series 3	749196131	749196231	749196331	749196530	749196531	749197131	749197231	749197331
AG	19415	26233	27119	56941	56819	42889	44196	45451
series 4	749196141	749196241	749196341	749196540	749196541	749197141	749197241	749197341
AG	25013	33012	32059	72345	72785	70430	73624	76878

Imaginary3. AG parameters range

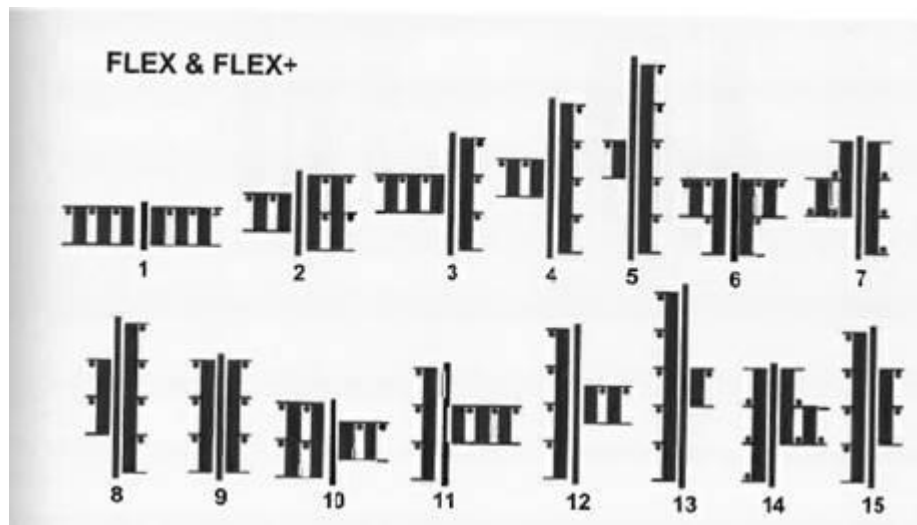
For example, we want to simulate a part of transformer 749196101 with a ferrite temperature of 25°C, then we need to find corresponding model in FLEX_7491961_1_25 and place it in a schematic, then click “.op” to add in the simulation directive. In this case, we need to input “.Param AG=772”. This command can be integrated in a global. Parameter command can also containing the parameter of the windings wiring for the chosen transformer or inductor.

We can see from the table, there are 5 rows and 8 columns. From top to bottom, the versions increase with an increasingly wide air gap and rising saturation current, as well as decreasing self-induction values. From left to right, there are AG values for different kinds of sizes of transformers, also with an increasing air gap.

It is worth to attract our attention that AG values do not change when temperature changed.

b) PR、PL、SR、SL

After having configure the value of AG, we also need to know the wiring chosen for the model. Such as PR, PL, SR and SL. We need to search corresponding parameters according to its connection. The following pictures show 15 kinds of connections and parameters of each connection, we can also search in file T1 to find information needed.



Imaginary4. 15 kinds of transformer models

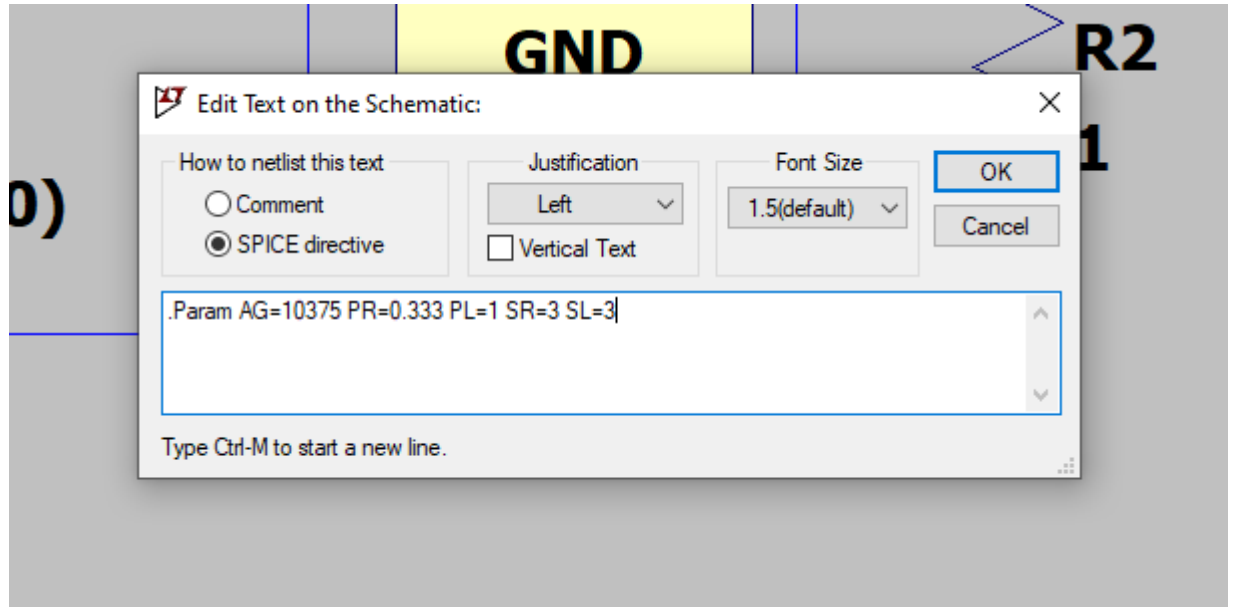
connection	1	2	3	4	5	6	7	8	9
PR	0.333	0.5	0.333	0.5	1	1.5	1.5	2	3
PL	1	1	1	1	1	2	2	2	3
SR	0.333	1	3	4	5	1.5	3	4	3
SL	1	2	3	4	5	2	3	4	3
Isat	3	2	3	2	1	1.15	1.15	1	1
In	3	2	3	2	1	1	1	1	1

Connect	10	11	12	13	14	15	
PR	1	3	4	5	3	4	xRP1
PL	2	3	4	5	3	4	PL^2xLp
SR	0.5	0.333	0.5	1	1.5	2	XRS1
SL	1	1	1	1	2	2	SL^2LxLS
Isat	2	1	1	1	1	1	XIsatbase
In	2	1	1	1	1	1	XIbase

Imaginary5. parameters of WE-FLEX

We can see from the table there are 15 kinds connection of each version of transformer, and there are 40 kinds of versions, so we can simulate 600 kinds of transformers.

Once we have configured parameters, we can input command about PR, PL, SR and SL. For example, if we want to simulate 749196311, with winding wiring N°3, used in a magnetic at 100°C, we can add a simulate directive to the schematic, including the configuration of AG, explained in the previous paragraph. As showing in below picture:



Imaginary6. Simulation directive

Here the same as AG, wiring chosen of the model does not change when temperature changed.

C) T2 file

T2 file is a gather of AG and T1 introduced previously, we can also search value directly when we have configure the detail information of a transformer. Meanwhile, there are also other parameters in the left of the table: the turns ratio L_s/L_p 、 self-induction of the primary L_p 、 saturation current I_{sa} and self-induction of the secondary L_s . And it is contained 600 kinds of transformers mentioned previously.

Additional, because of the different temperature, saturation current are also not equal. It is 30% lower, compared at 25°C. so we'd better keep a safety margin , we can reduce the value of current I_{sat} by about 30%.

L_s/L_p	L_p	I_{sat}	L_s	part number	Comb	AG	PR	PL	SR	SL
5	3,4	4,18	85	749196540	5	72345	1	1	5	5
2	3,4	8,36	13,6	749196540	2	72345	0,5	1	1	2
4	3,4	8,36	54,4	749196540	4	72345	0,5	1	4	4
1	3,4	12,54	3,4	749196540	1	72345	0,333	1	0,333	1
3	3,4	12,54	30,6	749196540	3	72345	0,333	1	3	3
5	4,3	2,91	107,5	749196530	5	56941	1	1	5	5
2	4,3	5,82	17,2	749196530	2	56941	0,5	1	1	2
4	4,3	5,82	68,8	749196530	4	56941	0,5	1	4	4
1	4,3	8,73	4,3	749196530	1	56941	0,333	1	0,333	1
3	4,3	8,73	38,7	749196530	3	56941	0,333	1	3	3
5	5,3	2,53	132,5	749196520	5	46018	1	1	5	5
2	5,3	5,06	21,2	749196520	2	46018	0,5	1	1	2
4	5,3	5,06	84,8	749196520	4	46018	0,5	1	4	4
1	5,3	7,59	5,3	749196520	1	46018	0,333	1	0,333	1
3	5,3	7,59	47,7	749196520	3	46018	0,333	1	3	3
5	6,6	1,55	165	749196241	5	33012	1	1	5	5
2	6,6	3,1	26,4	749196241	2	33012	0,5	1	1	2

Imaginary7. Table of T2

D) Finally, we can create a complete schematic if we have finished above operations. Set up site and click run to simulate.