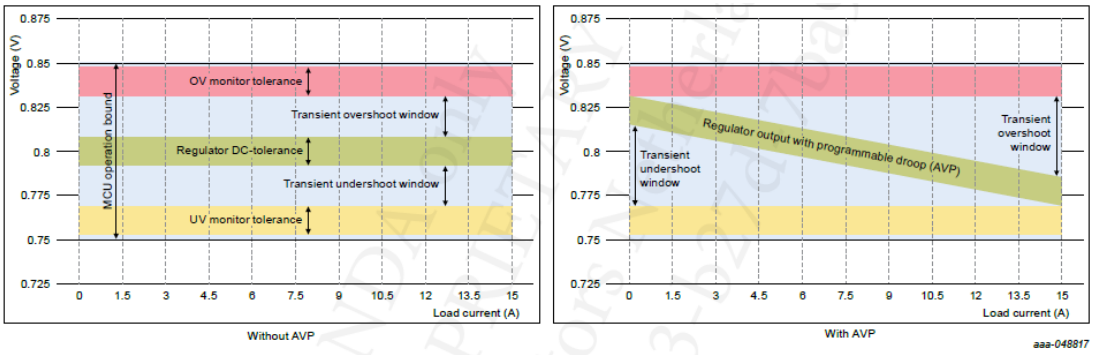
FS53XX AVP function introduce and simulation

As we all know that the transient response load transient is the important parameter for the SMPS specification, especially in the low voltage high current requirement power regulators. So for decrease the voltage drop during load transient, I introduce a new technique named adaptive-voltage positioning(AVP) in FS53XX COT structure, which can give much the benefits such as getting low output voltage peak to peak deviation and no increase the filters' parameters, in other words smaller filers' parameters bring the same output voltage P to P deviation.

The basic theory of AVP is below:
When light load the output voltage is set to slightly higher than normal level.
When heavy load the output voltage is sent to slightly lower than normal level.

So under this AVP load regulation is degraded but load transient deviation will be improved.
For the FS53XX side ,while the output voltage stays constant with respect to low without AVP, the output voltage droops linearly with load when AVP is enabled. This increases the headroom available for transient under and over shoots, thereby resulting in a reduced output capacitor requirement.



The AVP slope is programmable via OTP using the OTP_SW1_AVP[3:0] bits. Based on the available regulation window, the maximum expected load current, the AVP value can be chosen to provide the maximum use of the regulation window.

OTP_SW1_AVP[3:0]	AVP value (mV/A)
0b0000	0 (disabled)
0b0001	0.25
0b0010	0.5
0b0011	0.75
0b0100	1
0b0101	1.5
0b0110	2
0b0111	2.5
0b1000	3
0b1001	3.5
0b1010	4
0b1011	4.5

0b1100	5
0b1101	6
0b1110	7
0b1111	8

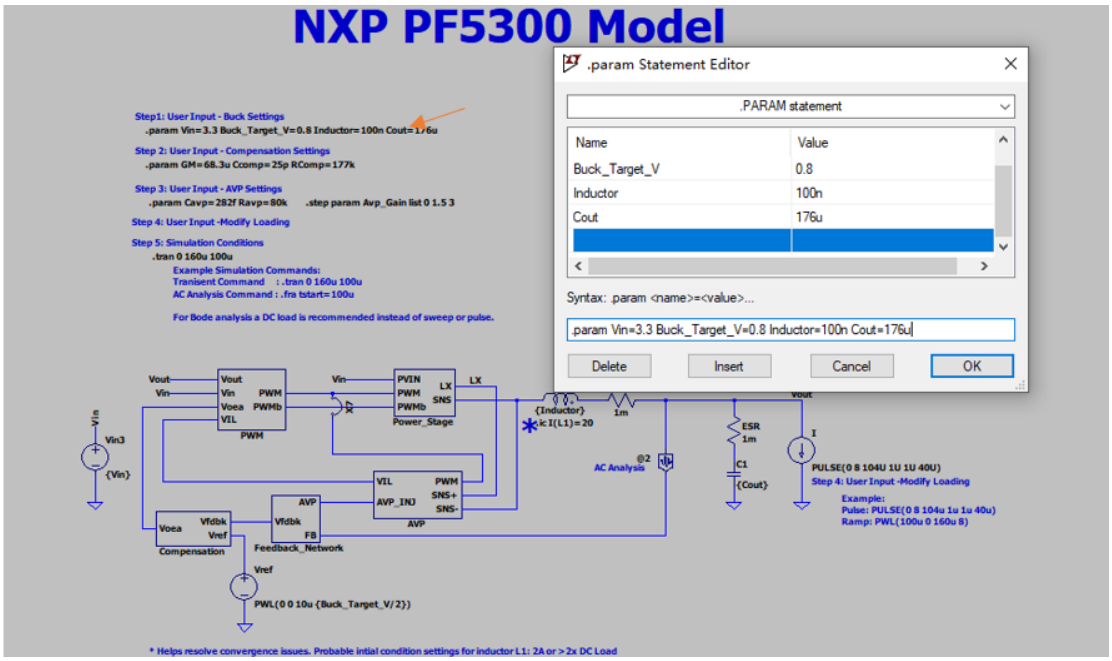
There are multiple factors to be taken into account when determining the output accuracy in an application when AVP is used. The AVP feature is dependent on the accuracy of the AVP loop and the accuracy of the current sense information.

Parameter	Symbol	Min	Typ	Max	Unit
Current Sense Accuracy	ISENSE	-7	-	7	%
AVP Setting Accuracy	AVP_0001	0.2	0.25	0.3	mV/A
AVP Setting Accuracy	AVP_0010	0.45	0.5	0.55	mV/A
AVP Setting Accuracy	AVP_0011	0.7125	0.75	0.7875	mV/A
AVP Setting Accuracy	AVP_0100	0.95	1	1.05	mV/A
AVP Setting Accuracy	AVP_0101	1.425	1.5	1.575	mV/A
AVP Setting Accuracy	AVP_0110	1.9	2	2.1	mV/A
AVP Setting Accuracy	AVP_0111	2.375	2.5	2.625	mV/A
AVP Setting Accuracy	AVP_1000	2.85	3	3.15	mV/A
AVP Setting Accuracy	AVP_1001	3.325	3.5	3.675	mV/A
AVP Setting Accuracy	AVP_1010	3.8	4	4.2	mV/A
AVP Setting Accuracy	AVP_1011	4.275	4.5	4.725	mV/A
AVP Setting Accuracy	AVP_1100	4.75	5	5.25	mV/A
AVP Setting Accuracy	AVP_1101	5.7	6	6.3	mV/A
AVP Setting Accuracy	AVP_1110	6.65	7	7.35	mV/A
AVP Setting Accuracy	AVP_1111	7.2	8	8.8	mV/A

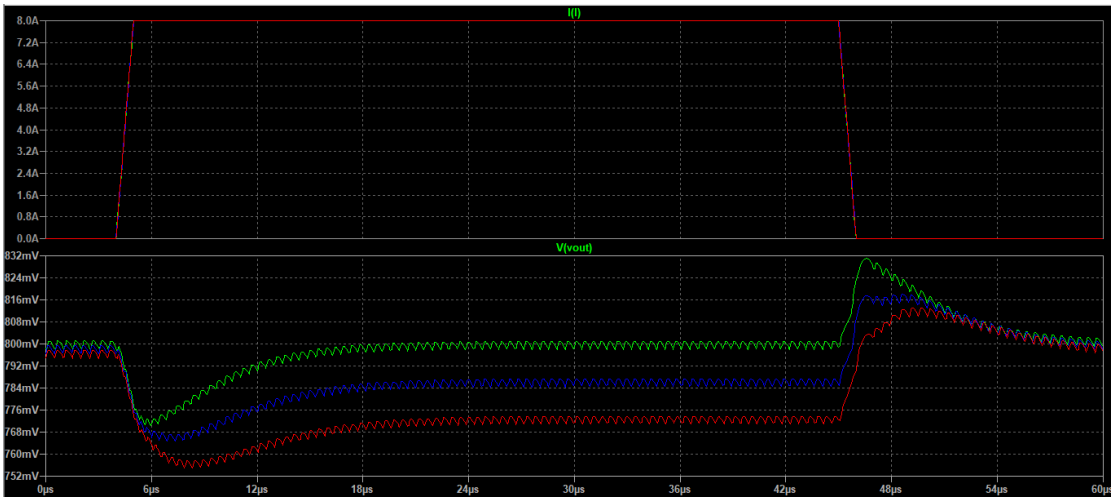
Simulation:

Open LTspice mode of PF5300,put the mouse into the black text and right click it,you can change the configuration value such as the VIN L VOUT COUT.

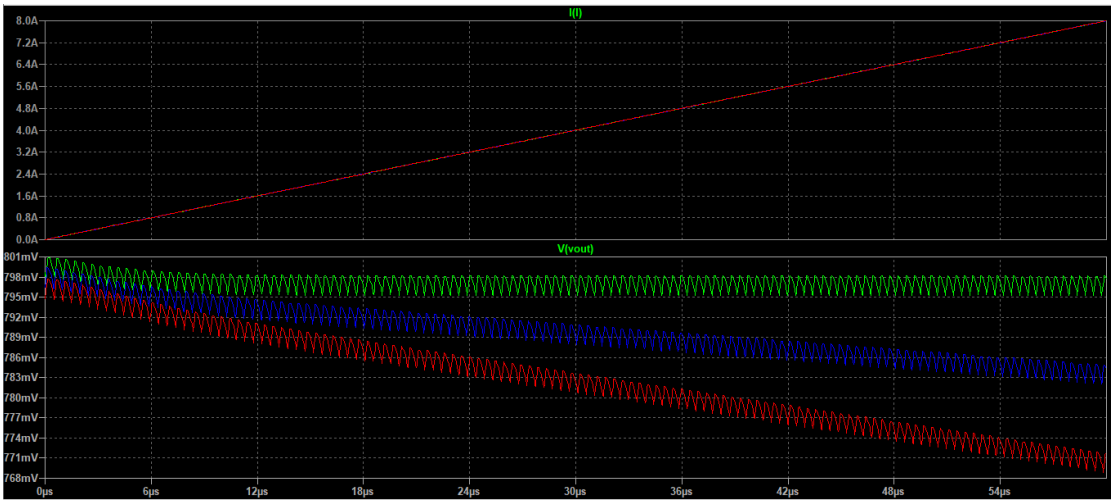
Same operations on below steps of you want to change others commands' value,for example you can change the AVP gain and the simulation results.



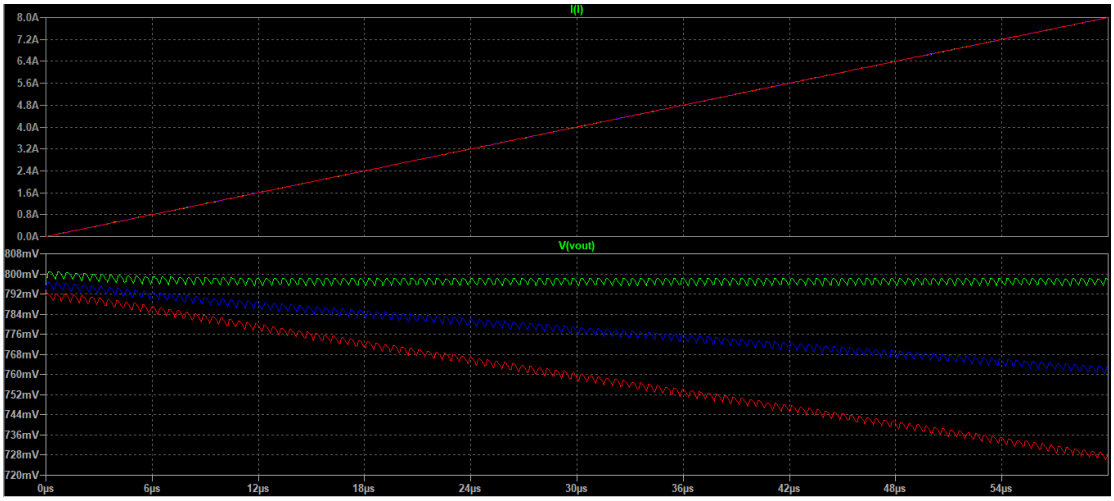
1: load transient simulation under different AVP gain,the gain are 0,1.5,3 and the load from 0 to 8A.



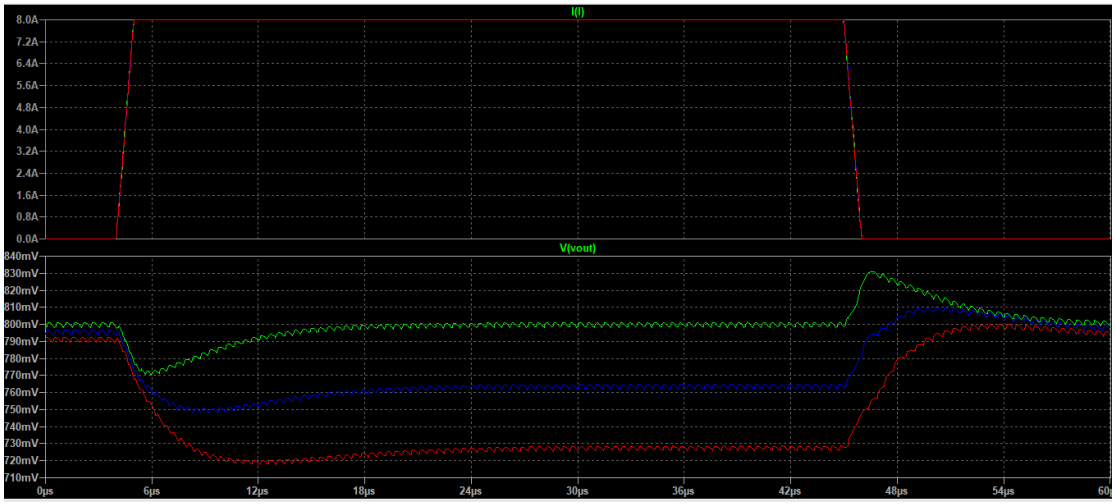
2: Under different AVP gain, the gain are 0,1.5,3,get different drop of VOUT with different load.



3: change the AVP gain 0,4,8:



4: Change the AVP 0,4 8:



5: Simulation LTSpice mode download link:

File Download (nxp.com)