ELECTRICAL ENGINEERING

I can’t seem to understand the preference of the flyback converters for the reason given below

Asked 1 year, 7 months ago Active 5 months ago Viewed 216 times

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Why would a flyback design normally have large energy storage components than an equivalent forward converter design but flyback converters are still preferred for low power designs requiring multiple isolated outputs?

power-supply power-electronics dc-dc-converter homework

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edited Jun 14 '20 at 8:12

winny

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asked Jun 13 '20 at 16:13

Kwaku E. Biney

73 4

I'm not super familiar with either type, but I do know that forward converters require more components than flyback converters. Forward converters are also limited in how high a voltage they can output, while flyback converters are (theoretically) able to reach arbitrarily high voltages. – Hearth Jun 13 '20 at 16:56

1 By "energy storage components", do you mean **only** the capacitors? Or do you also mean the magnetics? Because **both** are "energy storage components". And

By "energy storage components", do you mean **only** the capacitors? Or do you also mean the magnetics? Because **both** are "energy storage components". And do you mean the input caps, the output caps? Please clarify your question. Thanks. In particular, the flyback transformer often has a gap in which it stores a lot of its energy. – MicroservicesOnDDD Jun 14 '20 at 3:14

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When you talk about the differences between a flyback and or forward converter, you could say the following:

1. the flyback converter is usually suited for low to moderate output power (100-150 W as a practical maximum)
2. the flyback is well suited for moderate to high output voltages and low to moderate currents. For instance, 12 V/2 A, 5 V/1 A or 130 V/1 A in the old CRT applications
3. the flyback is cheap and requires a simple switch in the primary side plus a diode in the secondary side. Two windings in the basic configuration are needed for the transformer and a third one brings an auxiliary voltage for the controller V_{aux}.
4. the flyback works ok with large input voltage variations
5. the flyback is noisy in the output and generates quite high rms currents for the output capacitor
6. the flyback is inherently slow and suffers from a right-half-plane zero which depends on the load and duty ratio.
7. in current-mode control, the flyback suffers sub-harmonic oscillations.
8. the flyback is an extremely popular topology in the consumer market.
9. you can build multi-output converters easily but cross-regulation might be at stake.
10. so much more to say... :)

Now, the forward;

1. the forward is well suited for low output voltages and strong currents: 5 V/10 A or 3.3 V/30 A for instance.
2. the forward likes narrow input voltage ranges. You could not easily design a wide-range input forward converter like you would with a flyback.
3. the forward requires 1 switch in the primary, 1 diode for the demagnetization and two diodes in the secondary.
4. the transformer requires three windings, one power primary, one demagnetization winding (1:1 turns ratio with the primary usually) and a

4. the transformer requires three windings, one power primary, one demagnetization winding (1:1 turns ratio with the primary usually) and a third for the secondary side. A fourth winding will be necessary for the self-supply of the controller.
5. a forward requires an inductor in the secondary side, it is a buck-derived topology.
6. the forward is less sensitive to sub-harmonic oscillations because the magnetizing current plays the role of a compensation ramp. Sometimes it is enough, sometimes you need to add more.
7. the forward, as a buck, offers a non-pulsating output current and thus imposes a low rms current on the output capacitor.
8. the forward can be very fast with a high crossover. There is no RHP zero in a forward converter.
9. you cannot exceed 50% duty ratio for the basic configuration while you can easily exceed this number with a flyback converter.
10. multi-output is possible with excellent cross-regulation if output inductors are coupled.
11. member of the buck-derived topologies, the forward can be extended to a 2-switch version, a half-bridge, a full-bridge, a push-pull, an active clamp etc.

These are the few things I think about for these converters. The flyback is the cheapest and simplest to implement of the two and it explains its success in the consumer market. The forward, especially in its 2-switch version, it extremely rugged and was popular in PC silver boxes a while back. The active-clamp forward is popular in dc-dc bricks for the telecom market and PoE (power over Ethernet) applications.

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edited Jun 14 '20 at 7:13

answered Jun 13 '20 at 21:15

Verbal Kint
13.1k 1 10 36

many forwards converters run the primary push-pull this allows a higher power density for the same frequency and size of transformer. – Jasen Jun 14 '20 at 6:20

Yes, the push-pull is also a buck-derived isolated topology. – Verbal Kint Jun 14 '20 at 7:14

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Some thoughts: -

- Flyback transformers will quite often be smaller than transformers used in forward converters because they utilize the storage of energy in the primary winding. A forward converter has to avoid this and therefore, it has to have significantly more magnetization inductance and this often means a bigger size core and windings.

- A forward converter usually needs a split-wound transformer primary (for push-pull operation) whereas a flyback transformer doesn't.
- A flyback converter only really needs a single transistor drive interface (a MOSFET usually) whereas a forward converter needs a double transistor (push pull) drive interface.

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answered Jun 13 '20 at 17:25

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The forward drive trannys naturally have much more inductance because they don't have an air gap in the core, where as flyback ones have an air gap to increase the magnetization current. They are mainly smaller because they are in small power supplies. – Peter R. McMahon Aug 15 '21 at 2:08

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The transformer mainly, but the capacitor too, as it needs to supply the power while the transistor is topping up the transformer current. The energy is stored in the transformer as magnetization current. The transformer is larger because it only operates in one 1/2 cycle, where as the forward drive can be push pull and operate in both like a mains freq. transformer. Also, the current is ramping up to a peak in the primary and down from the peak in the secondary, so the peak to average current is greater making the rms current in the windings higher, requiring a bit thicker wire. For more than one isolated output, the forward drive types need post regulators on the extra outputs because the pulses out of the transformer are fixed voltage set by the I/P vol. x o/p to i/p turns ratio and, if not loaded the o/p inductors will not average the voltage. In flyback types, the transformer o/p vol. is not fixed as it is a current source during flyback and voltage is equal to the p/s output voltage plus the rectifier diode drop. Any extra outputs follow on approximately proportional to the main o/p voltage and don't need extra regulation unless an accurate voltage is needed.

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edited Aug 15 '21 at 3:23

answered Aug 15 '21 at 2:42

Peter R. McMahon
321 1 6