Design and Simulation of DC-DC converters using open source tools
Prof. L. Umanand
Department of Electronics System Engineering
Indian Institute of Science, Bangalore

Lecture – 20
Half and Full Bridge Converters

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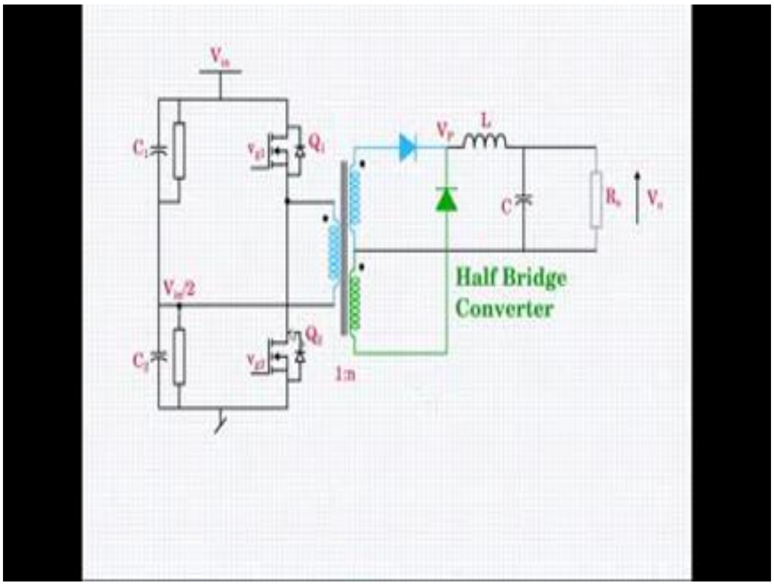

Now, this is a half bridge converter, now you see that the secondary portion remains unchanged exactly same as the case of a push pull converter and only the primary portion of the push pull converter has been changed. I have without loss of generality; I have changed the BJTs into MOSFET. So, I will get an idea how to put MOSFET symbols into the circuit you can definitely use the B J T you can also use the I g d t the MOSFET will have internal body diodes inbuilt. So, it also has advantages in that leakage can be taken care of. So, I have used the MOSFET here in a more generic sense. So, you have to power semi conductor switches Q 1 and Q 2 and you have to capacitances C 1 and C 2.

Now these 2 capacitances can be outputs of your rectifier filter circuits. The rectifier filter circuit has a C filter at the output and sometimes, the C filters are split equally like this half and half and with some meter registers to stabilize the voltage and you can have V in by across C1 and another V in by across C 2. So, this can be part actually part of the output portion of your rectifiers C filter cycle and you have 2 devices added as a bridge and the transformer. The primary of the transformer is 1 single coil not 2 coil like in the push pull connected across the bridge in this fashion.

So, such a bridge is called a half bridge, half bridge because you have instead of 4 switches in the case of full bridge you have half the number of bridges and therefore, the half bridge the half bridge is pretty simple. Now let us say Q1 is on. So, when Q1 is on Q 2 is off you cannot have Q 1 and Q 2 simultaneously on because then that would be a virtual short circuit or right through and your supply will go back. So, therefore, either Q 1 is on or Q 2 is off they have to be mutual exclusive. So, I will take this citation and Q 1 is on when, the Q 1 is on V in comes to this point. So, the dot end is at V in the non dot end is connected to the midpoint of the C 1, C 2 combination and therefore, this is a V in by 2. So, you have V in here; you have V in by 2 and what voltage appears across the primary is V in by 2 V in minus V in by 2 which is V in by 2 and that is amplified n times tool secondary sight. So, n mean 2 comes here and therefore, the pole voltage is n V in by 2 and therefore, by deduction V naught will be n V in by 2 into d.

So, this will be the output input output relationship and this is the operation of the half bridge converter during the time and Q 1 is off and Q 2 is on you will see that dot end is pulled to the ground non dot end is that V in by 2. So, therefore, you have 0 minus V in by 2 which is minus V in by 2 coming across the primary with non dot end positive more positive with respect to the dot end, the non dot end being positive means that the green portion of the secondary cycle gets activated and you have the current flow in this fraction.

Again you will see n times V in by 2 appearing at pole and charges of the inductor operation exactly similar to the push-pull secondary sides are exactly similar to the push pull secondary configuration. So, this will be switching between plus V in by 2 and minus V in by 2 during the time when Q 1 and Q 2 are off the inductor is prevailing. As in the cases of push pull dividing the current equally between in the 2 half of the secondary and because was canceled the voltage across the secondary 0 and therefore, the voltage because the flux is not changing d five by d t is 0 the voltage across the primary is also 0 and Q 1 will be seen V in minus V in by 2, so V in by 2 during the off state V in by 2 during the time during the time when both are off.

However you should not rate Q 1 and Q 2 for V in by 2 because, when Q 2 is on Q 1 is seeing for example, let us say Q 2 is on this point is at 0 potential connected to the ground this point is a V in Q 1 has to be stand V in during the time of Q 1 is on this point is that V in and this point is at ground. Therefore, Q 2 should handle V in. So, when you rate the device they have to be rated for maximum at least V in it should be greater than v n. So, this is how the half bridge configuration or connector configuration works the full bridge configuration is nothing, but this capacitors are replaced by 2 more switches.

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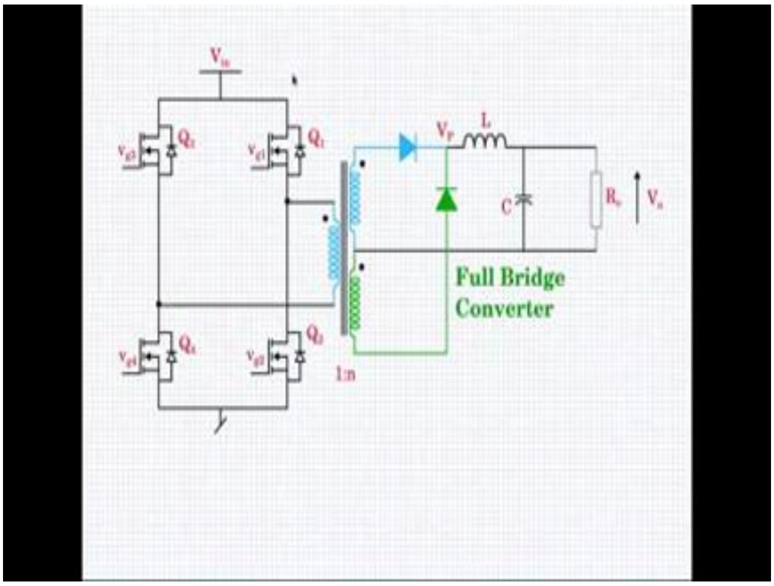

So, let me show you that see here that the half bridge converter is now converted into a full bridge converter by replacing the capacitor divider by 2 more extra switches Q 3 and Q 4, so Q 1, Q 2, Q 3 and Q 4. Now forms a full bridge converter. Always remember never to give in such a way that Q 1 and Q 2 are simultaneously on. So, that there is no short circuiting of the V in to ground likewise we should not give to Q 3 and Q 4 in such a way that they simultaneously on again in order to avoiding short circuiting this supply v n.

Now, what we will do is we will give the same get signal to Q 1 and Q 4 meaning Q 1 and Q 4 are turned on simultaneously Q 3 and Q 2 are turned on simultaneously. So, when Q 1 and Q 4 are turned on dot side is connected to V in here the non dot end is connected to ground. So, you see the full V in coming across the primary what comes across the secondary is n times V in now, because of the dot end is positive this dot end is positive divert blue divert will conduct.

So, you have n times V in coming to v p during the time when Q 3 and Q 2 are on and Q 3 is on you see that non dot end is connected to V in dot end is connected to the ground and therefore, you see a minus V in coming across here or the non dot end is having positive V in and on the secondary side V n, V n positive at the non dot end side. So, the green portion of the circuit is activated and charges of the l exactly similar way like we saw for the push pull secretary side operation.

So, you will have n V in n V in into d will be the output V naught because this is a buck converter operation. So, this is how the full bridge converter operates and during the period when all switches are off you will see that the inductor will pre read as we have discussed earlier to push pull case with half the current going into the blue winding another half going into the green winding both an opposite magnetic sense. Therefore, will cancel and the voltage generator will be is 0 because D5 by Dt is 0 voltage here is also 0.

During the time because this is 0 and you will see the other end is V in the voltages across the switches are V in and during the time when the opposite switches are on Q 3, Q 2 will be seeing V in it should be stand V in and during Q 3, Q 2 being on Q 1 and Q 4 should be stand V in. So, the voltage ratings of all the switches should be greater than V in 1 thing that you can see is that the voltage that is applied across the primary is V in in the case of the half bridge it was V in by 2. So, for the same power rating and same V in you will see that double the current as to flow through the switches in order to get the same power output because, V in has become half here.

So, therefore, I in has to the primary current has to double to have the same power transfer to the second in the case of the full bridge half the current corresponding to the half bridge will be flowing in the switches and therefore, the full bridge is capable of handling higher power compare to the half bridge for the same rating of the switches. So, this is how the full bridge converter operates and you see that now in all the 3 converter the push pull the full half bridge and the full bridge the secondary side is exactly identical in the operation is similar.