AND8187/D

Synchronizing NCP1207 (NCP1377/B, NCP1378)

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APPLICATION NOTE

To avoid problems caused by the presence of signals of different frequencies inside the same apparatus, it is sometimes necessary to synchronize the switching frequency of the power supply (for tuner compatibility, for instance). Instead of designing a specific controller for those kinds of applications, the NCP1207 can easily be used due to its inherent turn−ON control capability. This application note is fully applicable to the other controllers of the family, i.e., NCP1377 and NCP1378.

Synchronization

NCP1207 is meant to be a quasi−resonant controller, in which the turning ON is dictated by the demagnetization pin (pin 1). As long as the voltage on DMG pin is above 50 mV, the DRV stays low, and when the DMG pin voltage crosses the 50 mV threshold, the DRV goes high (Figure 1). A minimum T_{OFF} duration is always ensured to prevent the switching frequency to go too high.

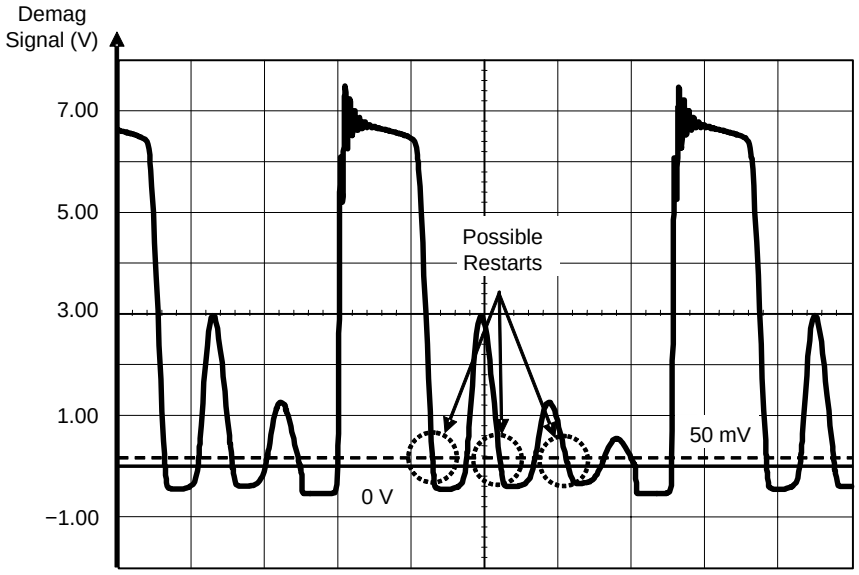

Figure 1. NCP1207 Switches ON when the Voltage on its DMG Pin Crosses Down the 50 mV Threshold

It is thus possible to use this pin to synchronize the turning ON with an external signal. This signal must be high to maintain the OFF state, and then go low to authorize the turn−ON.

This signal must fulfill three major requirements:

- The low state duration must be shorter than the internal blanking time T_{BLANK} (8.0 μs typically), to avoid working in fixed T_{OFF} mode. As this will happen if the low state duration is longer than $T_{ON} + T_{BLANK}$, a duration shorter than T_{BLANK} (8.0 μs) will be safe.
- The low state voltage must always be lower than 50 mV, even in a noisy environment; the safer would be a slightly negative value.
- The high state voltage must be lower than the overvoltage threshold V_{ref} (7.2 V typically).

Based on these assertions, we can define the best synchronization signal to apply (Figure 2).

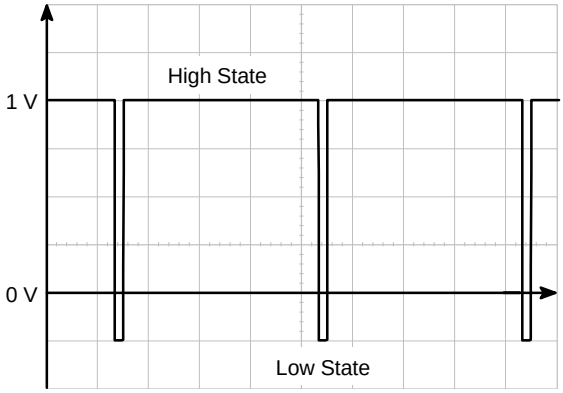

Figure 2. The Best Synchronization Signal for NCP1207

However, it is not practical to generate a negative voltage, so we recommend using a positive signal and inserting a small circuit (made of a capacitor C0, in parallel to a resistor R0) in series to shift it. An additional series resistor, R1, allows reducing the high state voltage if needed (Figure 3), by dividing the voltage applied due to the internal 30 kΩ impedance of the pin.

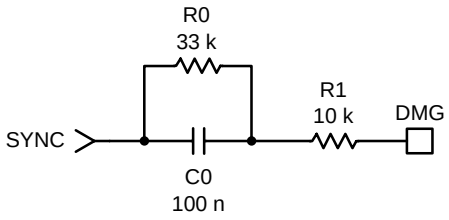

Figure 3. This Circuit Allows Using a More Practical Positive SYNC Signal

With this arrangement, the synchronization signal can have a low state above 0 V and a high state above 7.2 V. The signal applied to DMG pin will be shifted down, ensuring a slightly negative low state, and the high state value can be adjusted by changing the value of R1. R1 is not needed if the maximum voltage of SYNC is lower than 5.0 V.

The signal finally applied to the NCP1207 DMG pin can be seen in Figure 4. From the DRAIN waveform, one can see that the power supply is running in synchronized mode.

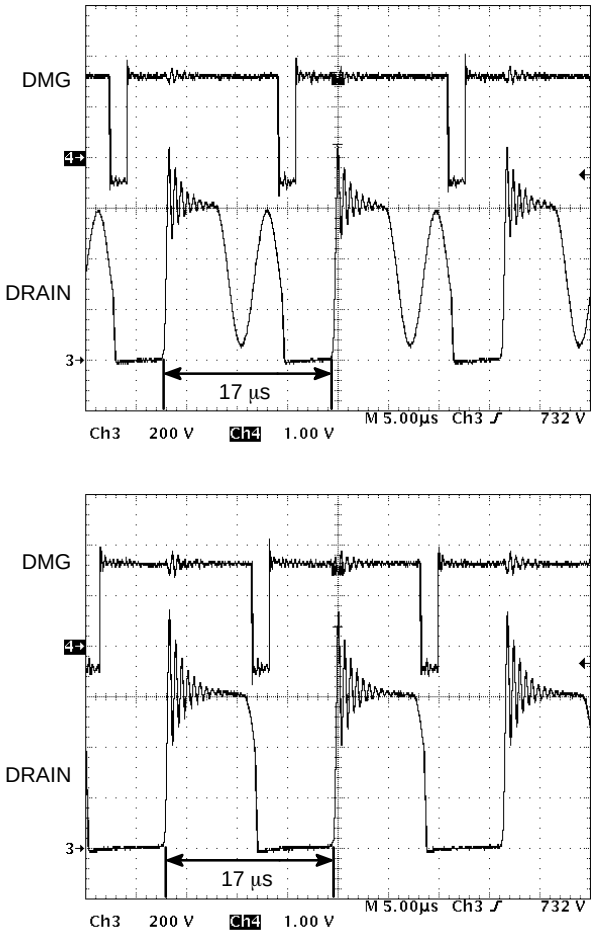

Figure 4. Switching Frequency is Forced by the SYNC Signal for Two Different Load Conditions

Synchro OFF

It can be interesting to switch ON and OFF the synchronization. When the synch is OFF, the controller must keep on switching, but asynchronously. Two solutions are possible:

- **Variable T_{ON}, Fixed T_{OFF} Mode**
  By connecting the demagnetization pin to ground, the NCP1207 is running in fixed T_{OFF}, variable T_{ON} mode. T_{OFF} duration is given by the internal blanking time T_{BLANK}, and T_{ON} is dictated by the current mode. This mode is very interesting as no external components are needed on DMG pin (Figure 5).

The simplest way to switch between the two modes is to always apply the SYNC signal to the DMG pin, but ground this pin when the synchronization is not needed. As the voltage on the pin must be lower than 50 mV, it is not possible to use a bipolar transistor, due to its V_{CEsat} usually greater than 100 mV. We thus recommend the use of a small MOSFET like the 2N7000 (Figure 5), or connect the emitter of a bipolar NPN to a slightly negative voltage.

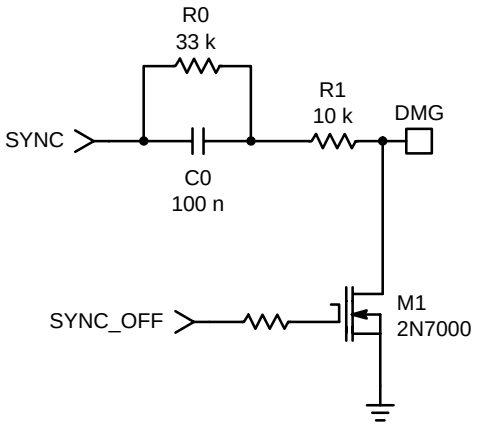

Figure 5. A Simple MOSFET Allows Switching from Free−Running to Synchronized Mode

- **Quasi−Resonant Mode**
  The quasi−resonant mode of operation is the typical one for which NCP1207 has been designed. The DMG pin (pin 1) is used to monitor an auxiliary winding and detect the core reset of the transformer (see data sheet for details).

Switching from synchronized to quasi−resonant mode is more complicated and requires splitting resistors in order to insert bipolar transistors. Those transistors will act as switches to open one and close the other path (see a possible implementation in Figure 6).

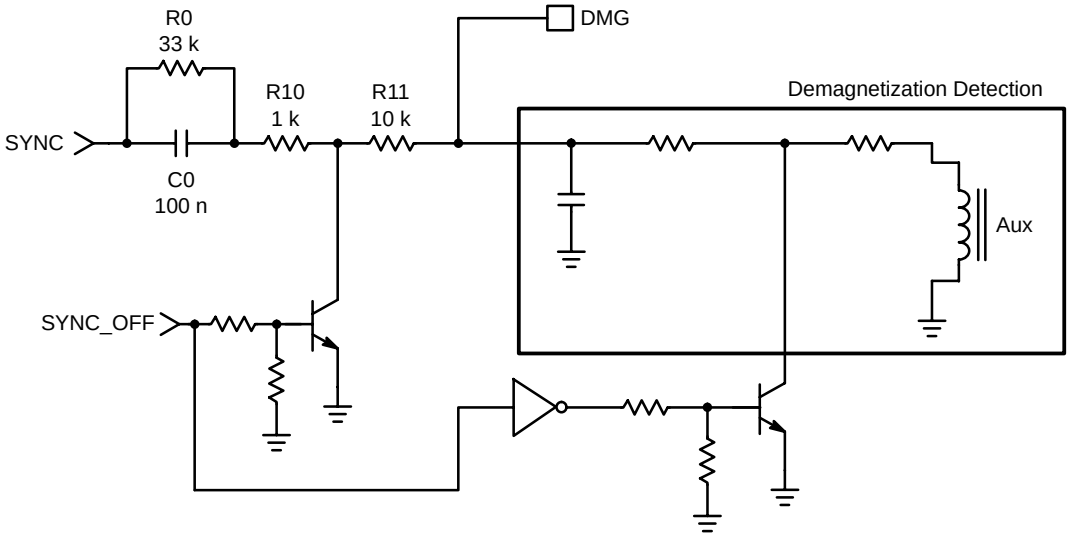

Figure 6. A Possible Way to Switch from Synchronized to QR Mode of Operation

Conclusion

NCP1207 and the other controllers from the same family (NCP1207A, NCP1377, NCP1377B and NCP1378) offer a cheap and easy way to synchronize the switching frequency of a power supply without using a dedicated controller. If a simple synchronization is not enough, it is even possible to implement more advanced features (like switching between different modes of operation) with few additional components.

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