

IR-1308

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SOFT START CIRCUIT FOR SELF-OSCILLATING DRIVERSRELATED APPLICATIONS

This application is related to and claims the
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5 60/010,720, filed January 29, 1996 [IR-1308 (PROV)].

FIELD OF THE INVENTION

This invention relates to power MOSgate device
drivers, and more specifically relates to a self-
oscillating driver for a lamp ballast which has soft
10 start characteristics.

BACKGROUND OF THE INVENTION

One of the basic limitations of self-
oscillating MOSFET drivers such as those of the IR215X
and its family of devices sold by the International
15 Rectifier Corporation of El Segundo, California, is their
inherent constant frequency operation when the R_T and C_T
inputs are fixed values.

In a ballast application, this causes a high
current demand from MOSFETs connected in a 1/2 bridge as
20 soon as oscillation commences and after an undervoltage
(UV) lockout voltage is exceeded.

In optimized ballast designs where the MOSFETs
are selected to provide adequate performance for steady
state operation, the additional starting current
25 overstresses the MOSFETs, resulting in a high failure
rate.

BRIEF SUMMARY OF THE INVENTION

The circuit of the invention eliminates the above-described problem by soft starting the lamp even after a momentary input power interruption. It further eliminates the need for PTC thermistor-starting circuits with their inherently poor reliability.

The novel circuit produces a significant cost-saving performance enhancement and reduction of component-count over alternative designs for all ballasts using self-oscillating drivers.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic diagram of a prior art 1/2 bridge ballast circuit for gas discharge lamps, such as fluorescent lamps.

Figure 2 is a schematic diagram of a circuit of the present invention.

Figure 3 is a schematic diagram of a second embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The circuit of Figure 1 is a basic known self-oscillating 1/2 bridge where an output square wave frequency is determined from the values of R_T and C_T connected to chip 10, which is a type IR215X chip. A positive voltage V_T is supplied to pin V_{CC} through a dropping resistor R_s . A conventional boot strap circuit consisting of diode 12 and capacitor 13 is provided. As stated above, it is possible for a high starting current to damage power MOSFETs 10 or 11.

In a first embodiment of the invention, the novel soft starting ballast of the invention makes use of a diode array 20, as shown in Figure 2 to charge and

discharge the timing capacitor C_T . The array 20 consists of five 1N914 diodes, and capacitor C_T is 0.0022μ .

Resistor R_T has a resistance of 24.5k. In the improved circuit, oscillation starts (as in Figure 1) as soon as a
5 minimum undervoltage V_{UV} is exceeded. However, because the bi-directional diode array 20 subtracts a portion of the capacitor charging or discharging voltage, the oscillation frequency of R_T and C_T is higher than if no diodes were present.

10 As V_{CC} increases from V_{UV} to the normal operating voltage, usually from about 9 volts to 15 volts, the diode array 20 subtracts a constant voltage from the C_T charge/discharge voltage. The C_T switching points are $1/3$ and $2/3$ of V_{CC} which is increasing. Thus
15 the actual C_T switching voltage also increases proportionately. Since the diode array voltage is constant and independent of V_{CC} it follows that the charging and discharging voltages of C_T are not finite $1/3$ and $2/3$ of V_{CC} but, in fact, as V_{CC} changes, these
20 voltages are a linear function of V_{CC} as described by the equation:

$$f_{osc} \propto 1/V_{CC} + k$$

where k is the undervoltage lockout voltage V_{UV} .

In operation, the frequency is high at the
25 start of oscillation and decreases as V_{CC} is raised. The rate at which this process takes place can be used to perform a timed preheat cycle; then a soft lamp start at near resonance; and finally a controlled power level as the final oscillation frequency is reached. Whenever a
30 power interruption causes V_{CC} to be reduced, the soft starting process is repeated.

Figure 3 shows a second embodiment of the invention, wherein the diodes 20 of Figure 2 are replaced by a 2 volt zener diode 30 and capacitor 31. A variable positive voltage is then applied to the V_{cc} pin of the
5 IR215X chip. The frequency f_{osc} can be shown to be proportional to V_{cc} above V_{uv} , which is an ideal scenario for a soft start ballast drive circuit.

Although the present invention has been
described in relation to particular embodiments thereof,
10 many other variations and modifications and other uses will become apparent to those skilled in the art. It is preferred, therefore, that the present invention be limited not by the specific disclosure herein, but only by the appended claims.



WHAT IS CLAIMED IS:

1. A control circuit for a resonant load to impart soft start characteristics to the resonant load; said control circuit comprising a pair of power MOSFETs connected as a half bridge connected to said resonant
5 load to drive said load at a frequency determined by the frequency at which said power MOSFETs are alternately turned on and off; a source of voltage V_{cc} connected to said pair of power MOSFETs; said control circuit including circuit means having input terminals connected
10 to said source of voltage V_{cc} and output terminals whereby gate turn-on signals are produced at said output terminals and are connected to the gate terminals of said pair of power MOSFETs; the frequency of operation of said output terminals being controlled by the input to said
15 input terminals; and constant voltage means connected to said input terminals for subtracting a constant voltage from the voltage applied to said input terminals, thereby to cause soft start of said circuit as the voltage V_{cc} increases toward its operating value.
2. The control circuit of claim 1 wherein said resonant load is a lamp ballast.
3. The control circuit of claim 1 wherein said constant voltage means comprises a zener diode.
4. The control circuit of claim 1 wherein said constant voltage means comprises at least two strings of diodes in anti-parallel connection with one another.



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5. The control circuit of claim 3 wherein said resonant load is a lamp ballast.

6. The control circuit of claim 4 wherein said resonant load is a lamp ballast.

7. The device of claim 1 wherein the voltage at said input terminals changes to produce a frequency of oscillation of said resonant load which is proportional to the inverse of V_{cc} plus a constant.

8. The device of claim 2 wherein the voltage at said input terminals changes to produce a frequency of oscillation of said resonant load which is proportional to the inverse of V_{cc} plus a constant.

9. The device of claim 5 wherein the voltage at said input terminals changes to produce a frequency of oscillation of said resonant load which is proportional to the inverse of V_{cc} plus a constant.

10. The device of claim 6 wherein the voltage at said input terminals changes to produce a frequency of oscillation of said resonant load which is proportional to the inverse of V_{cc} plus a constant.

11. The device of claim 1 wherein said circuit means having input and output terminals is in the family of IR215X integrated circuit chips.

12. The device of claim 11 wherein said input terminals comprise the R_T and C_T terminals of said chip.



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13. The device of claim 12 wherein the voltage at said input terminals changes to produce a frequency of oscillation of said resonant load which is proportional to the inverse of V_{cc} plus a constant.

14. The control circuit of claim 13 wherein said resonant load is a lamp ballast.

15. The control circuit of claim 14 wherein said resonant load is a lamp ballast.

16. The control circuit of claim 15 wherein said resonant load is a lamp ballast.