DANGERS ASSOCIATED WITH POLARITY REVERSAL ON DC APPLIANCES AND IT REMEDY

Engr. Makinde K.,
Department Of Electrical Engineering,
Federal Polytechnic Bida, Niger State
Ogbonna V. O.,
Department Of Electrical Engineering Nnamdi Azikiwe University Awka, Anambra State
Abolaji S. K.,
Department Of Electrical Engineering Auchi Polytechnic, Edo State
Onu C.,
Department Of Electrical Engineering,
Federal Polytechnic Bida, Niger State

Abstract

Direct current (DC) appliances have already become an important source used in many appliances across a wide range of generating alternative power supply. Reverse polarity has destroyed so many inverters, cause fire out breaks and so on. This work is mainly concerned with dangers associated with of polarity reversal on electronics appliances and how they can cheaply be prevented and protected as the case of an inverter. This is achieved by incorporating a load relay between the battery and the inverter and a diode in series with the relay coil terminal such that a unidirectional flow of dc source is allowed.

Keywords: Inverter, Relay, Diode, Dc source, Fuse

Introduction

Most machines are clearly marked as to what the terminals are, or how they can be set for either polarity. Some machines have a switch to change polarity, whereas on others it is necessary to change the cable terminals (Lincoln, 2014). In most machines the later is applicable.

Similarly, a lot of electronic equipment designed to be operated from a battery is fitted with an internal diode in series with one battery lead, to protect the equipment from damage if the connections to the battery are

accidentally reversed. But this type of reverse polarity is generally not fitted to DC-AC inverters, because of the heavy current drain involved. The additional voltage drop introduced by a diode would degrade the inverters regulation too much, quite apart from wasting power and hence reducing the overall efficiency. If reverse polarity protection is provided (fig.1.), this is usually in the form of a protective fuse or circuit breaker in series with the battery leads, plus a reversed polarity power diode (D1) connected across the inverters, this means that when the battery leads are connected with the correct polarity, the diode is reverse biased and remains dormant. But if the battery connections are accidentally reversed, the diode (D1) is forward biased and suddenly conducts blowing the fuse and hopefully protecting the inverter itself. This system generally does provide protection against reversed-polarity damage to most of the inverter circuitry, without degrading its efficiency or output regulation. However the price you pay is that an accidental reversal of the battery connections still blows a fairly expensive high-current fuse, and sometimes also destroys the protective shunt diode as well. Probably for this reason, some lower priced inverters don't incorporate any specific protection against accidental reversal of the battery leads. So with these inverters, you have to be especially careful to connect the battery leads correctly .Even with inverters which are provided with protection, it's still a very good idea to double-check the connections before clipping on the second battery lead. Remember that a mistake will almost certainly mean a blown fuse at least, and possibly a long delay until you can replace it! (Jaycar, 2000). In this paper, a diode is connected in series with a load relay coil instead of the method previously discussed in this paper.

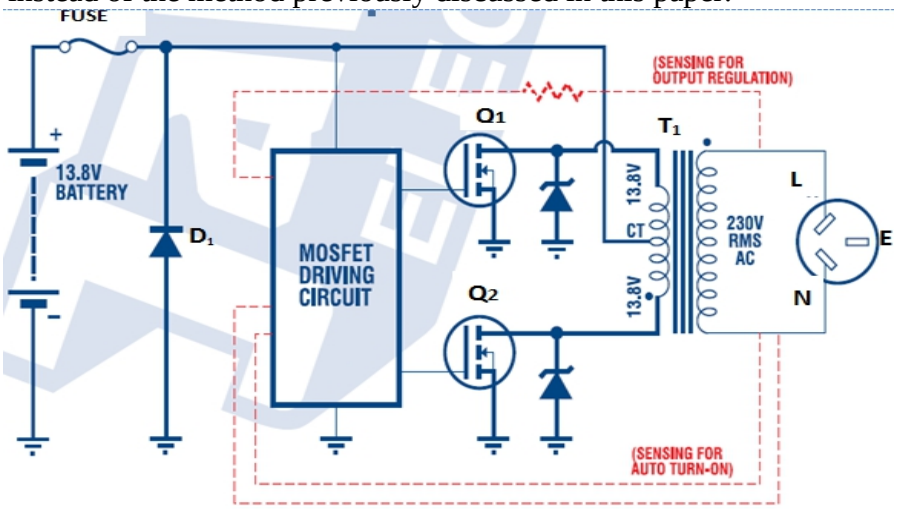


Fig. 1. Inverter circuit with polarized source D1
[D1 = diode, Q1 = Q2 = Mosfets, T1 = Transformer, L, N and E are live , neutral and earth respectively
(Sourced : Jaycar Electronics Reference Data Sheet: INVERTER.PDF (1))

Problems associated with reversed polariry

Inverters powered by voltages between 12VDC to 36VDC may not cause serious fire out breaks when leads are mistakenly reversed. But when voltage level is between 48VD to 192VDC in case of industrial inverter or appliances, reverse polarity will blow the device, destroy possibly the battery, set the power house ablaze and if not careful kill the operator.

Solution to reversed poalrity

Polarity results from the fact that an electrical circuit has a negative and a positive pole. Direct current (DC) flows in one direction, resulting in a constant polarity (Lincoln, 2014). Example of such component is called a diode. Alternating current (AC) flows half the time in one direction and half the time in the other, its polarity changes 120 times per second with 50-hertz current(Lincoln, 2014).

A diode is an electrical device allowing current to move through it in one direction with far greater ease than in the other. The most common type of diode in modern circuit design is the semiconductor diode, although other diode technologies exist. Semiconductor diodes are symbolized in schematic diagrams as shown in fig.2.

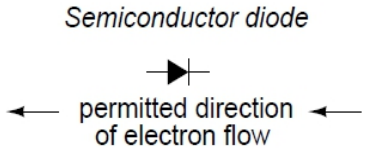
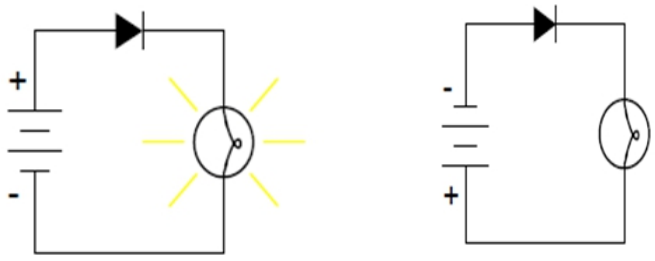


Fig .2. Diode symbol

When placed in a simple battery-lamp circuit, the diode will either allow or prevent current through the lamp, depending on the polarity of the applied voltage(fig..3).



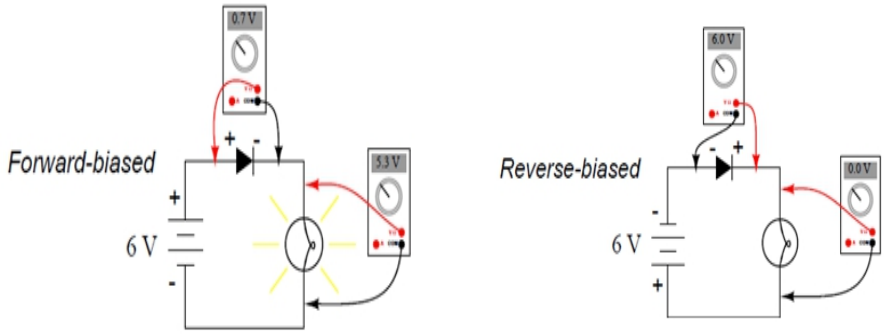
(a) Current permitted :Diode is forward biased

(b) Current prohibited: Diode is reverse biased

Fig..3 Diode operation

(Sourced : Lessons In Electric Circuits, Volume III, 2005)

When the polarity of the battery is such that electrons are allowed to flow through the diode, the diode is said to be forward-biased (fig.3a). Conversely, when the battery is "backward" and the diode blocks current (fig.3b), the diode is said to be reverse-biased. A diode may be thought of as a kind of switch: "closed" (fig. 4a) when forward-biased and "open" (fig. 4b) when reverse-biased (Tony, 2005).



(a)Forward-biased (b) Reverse-biased

Fig.4 Application of diode
(Sourced : Lessons In Electric Circuits, Volume III, 2005)

In this paper, the same principle of operation (fig.4) is applied to the load relay (fig.5). The diode allows the relay to energize only in forward-biased mode thereby allowing current to flow from the “normally" opened terminal” (NO) of the relay via the “common”. Since the positive terminal of the battery is connected to common (C) of the relay, when energized, the normally open becomes close and as such sends a positive source to the centre tapped of the inverter transformer and by so doing conduction will take place only in forward mode (fig.3a). This method has no any limitation on the required current needed to drive the inverter like in the case of fig.1.

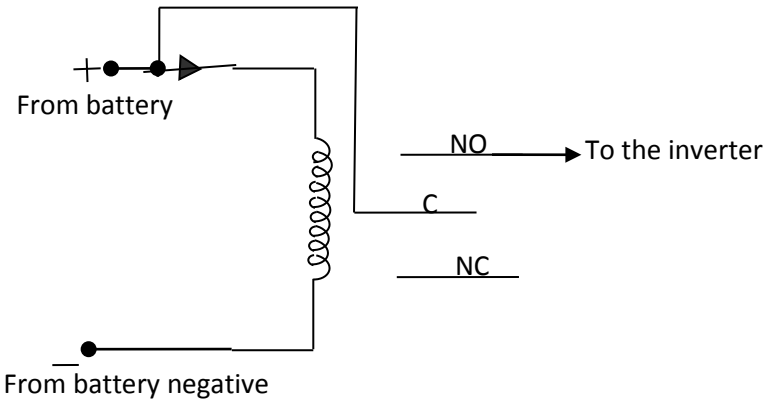


Fig.5 Protected load

Advantages of using a conditioned relay as means of polarity Reversal/protection in dc appliances (inverter)

1. The trouble of fuse replacement is eliminated
2. The working condition of the appliances/inverter is guaranteed even if the polarity of the battery is mistakenly reversed.
3. No case of any heavy current drained by the diode as it is not connected in parallel with the battery like in fig.1
4. The inverter/appliances regulation will not be degraded
5. Overall efficiency of the inverter is not affected

Conclusion

This paper is a viable one in the sense that it will go a long way in making it easier for users of inverters/dc source appliances to operate their appliances without entertaining any fear of spark, fuse blown or cause any damage to the inverter due to reverse polarity. Therefore, incorporating polarized load relay device is strongly advised in any dc source appliances especially in the area of inverters and battery chargers.

In conclusion, this paper is a design which should be encouraged and put into large scale manufacturing because of its various advantages.

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