Update: A Flashgun Isolator

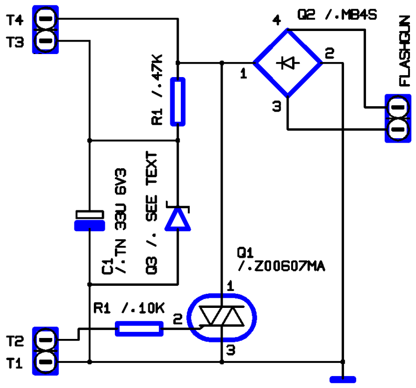
*Digital cameras can be damaged by connecting them to a traditional design of electronic flashgun. In this article, **David Gibson** describes the problem in more detail, and updates his isolator circuit from CREG Journal 60.*

In the last journal, I described (Gibson, 2005) a circuit to isolate the high voltage electronics of a flashgun from the sensitive circuitry in a digital camera.

Just as the issue went to press I realised that the design could be simplified. The trigger circuit includes an optional 100nF / 400V capacitor (C3) in series with the triac. The reason for this is that some designs of flashgun feature a trigger circuit that operates at a higher current than the holding current of the triac. However, it occurred to me – too late to correct the previous article – that this is only the case when the triac is driven by the sensitive opto-triac in my slave unit. Omit the opto-triac and the large 100n capacitor can also be omitted.

Next, it is debatable whether the fuse FS1 is really needed. Its purpose is to protect the triac if one uses the circuit with a slave unit, to fire a flashbulb directly, using an external battery. This is not a common use.

Thirdly, I discovered that the 'new' Zener diode, part number BZX399, has been discontinued. Perhaps there were manufacturing problems? With these changes, the revised diagram is…



Terminal	Use with slave for…	Use with Camera for…
T1	Gnd/Trigger	–
T2	–	Trigger
T3	+ve	Trigger
T4	Trigger	–

Figure 1 –Simplified flashgun isolator

To use the circuit to power my slave unit you should reduce R1 to 100Ω. Zener diode Q3 must have a very low reverse leakage current at the operating voltage. The best device I could find was the BZX99 series, but this is not widely available. The next best choice is the Fairchild BZX55C-5V6. This has a quoted I_R of 0.1µA at $V_R = 1.0$V. At the 30µA or so, which will be available at the trigger terminals, this diode will present 3V or so, which is adequate to fire the triac.

Measuring a Flashgun's Terminal Voltage

The problem, which this circuit and other similar ones; e.g. (Lappin, 2002) aim to solve is caused by flashguns that have a trigger circuit similar to shown in below.

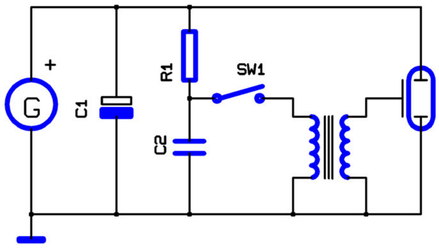


Figure 2 – Typical flashgun trigger circuit

Many variations on this circuit exist, so it should not be treated too literally. In fact, it is probably more usual for the position of SW1 and C1 to be swapped. In this particular embodiment, neither of the flashgun contacts on SW1 is connected to ground. This is the reason for the opto-isolator in my slave unit – if you want to power the slave unit from the flashgun's batteries, the opto-isolator prevents unwanted short-circuits.

When the flashgun charges up, the main storage capacitor C1 will reach perhaps 350V. C2 is small – perhaps only 10nF – and is charged via a high value resistor R1, which could be 10MΩ. Herein lies a problem – R1 means that is not possible to determine whether there is a high voltage present on SW1 by measuring the voltage across it. If – for the sake of argument – your voltmeter has a resistance of 1MΩ, then it will form a potential divider with R1 and will only record $1/11^{th}$ of the voltage.

The wide range of voltages recorded at **botzilla.com/photo/strobeVolts.html** is a testament, I assert, to the fact that they were measured with inadequate instrumentation.

One method of deducing the true rail voltage is to measure the short circuit current, and to measure it again with a series resistor (R_S) of, say 1MΩ. We then have

$$I_{short-circuit} = \frac{V_{rail}}{R_1} \qquad (1)$$

and

$$I_{series-R} = \frac{V_{rail}}{R_1 + R_S} \qquad (2)$$

so, eliminating the unknown R_1, we obtain

$$V_{rail} = R_S \Big/ \left(\frac{1}{I_{series-R}} - \frac{1}{I_{short-circuit}} \right)$$

For example, if the short-circuit current was 35µA, and the current with 2.2MΩ in series with the switch was 28.7µA then the rail voltage must have been 351V.

The cause of the problem, with digital cameras (and, according to some reports, with mechanical switches on traditional cameras too) is the brief surge of current when C2, charged to 350V, discharges into the trigger transformer. What is it that causes the damage? Voltage or current? My assertion is that it is not, in fact, the voltage that causes the harm, it is the current (What is it that flows through the circuitry to cause damage?). So, provided the current is limited to a sensible value, no damage will be done.

Clearly if the gate of an FET has broken down due to voltage stress then even a small current is bad news. But most silicon circuitry has inherent 'catch diodes' that will divert current to the supply rails. It is this feature which provides protection against static electricity. So, my assertion is that it may be possible to provide protection simply by limiting the current to a safe value of a few milliamps. A resistor of 100kΩ in series with the switch might be enough to do this. But, of course, the circuit of ***Figure 1*** provides a more comprehensive protection.

Slave Unit Problems

I have received occasional reports of flashguns not working correctly when connected to my slave unit. Symptoms include erratic firing and inability to charge. The obvious cause of this symptom is that the current in the flashgun's trigger circuit exceeds the holding current of the triac. The cure is to ensure that the link on my slave unit is set to the position where the 100n / 400V capacitor is in series with the output. Do let me know if this does not cure your problems.

References

Lappin, Ted (2002), *A Camera Flash Adapter Cord*, Speleonics **23**, pp10-12. Online at **caves.org /section/commelect/spelonic.html** [sic].

Gibson, David (2005), *A Flashgun Isolator*, CREGJ **60**, p21, June 2005. Online at **caves.org.uk/flash/docs.html**

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