Portable defibrillators rely on reed relays in high-voltage charging circuit

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Portable automated external defibrillators (AEDs) are showing up regularly in places where large groups of people congregate, like airports and sports stadiums. This huge increase in the number of portable AEDs has not been driven by governmental regulation, but by the overwhelming evidence that they save lives.

And what helps to keep an AED ready to work reliably the first time, even if it has been sitting for weeks, months, and sometimes years? The hermetically sealed high voltage reed switches, in an epoxy sealed package, offer all the protection needed in difficult environments, such as moving vehicles or moist, dusty, dirty environments.

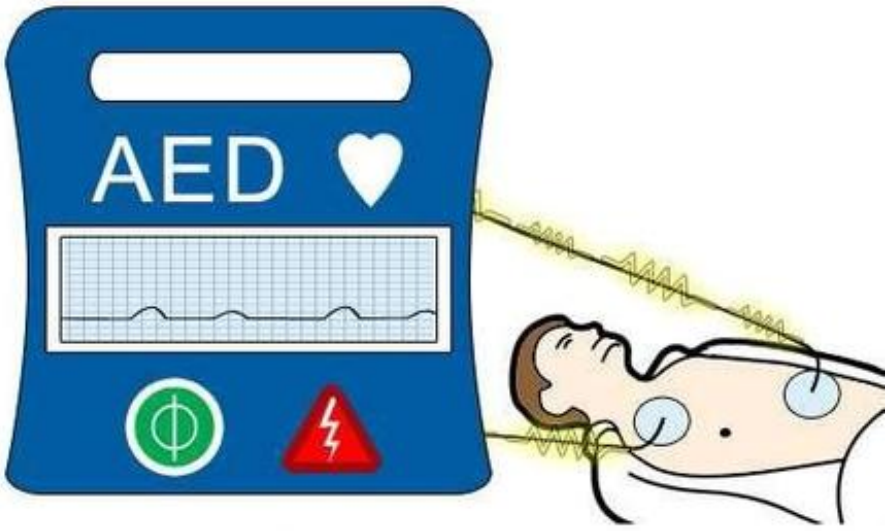
The rise in portable AEDs

Every year many thousands of peoples’ lives are saved by resuscitation in a hospital environment with a standard defibrillator after their heart stops beating. However, thousands of heart attack deaths occur every day among those unable get to a medical facility in time to be resuscitated. In fact, according to the American Red Cross, as many as 50,000 cardiac arrest fatalities could be prevented each year with the assistance of an AED, because an on-site AED reduces the amount of time necessary to restore normal heart function while waiting for medical assistance.

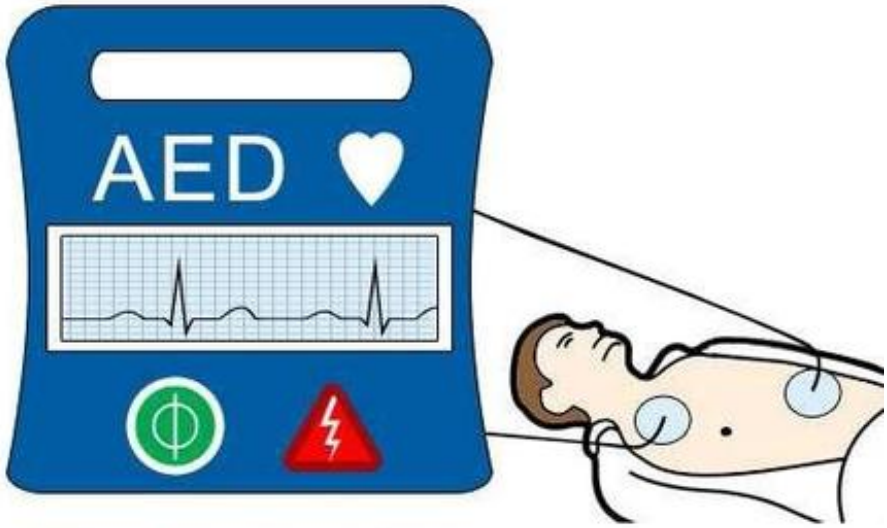
In response, medical equipment manufacturers have developed portable defibrillators that are being placed in public areas where people are apt to gather. Walk down the halls or aisles of airports, offices, shopping centers, restaurants, casinos, sports stadiums, schools, and health clubs, and you'll spot the ubiquitous box, just awaiting the time it will be called into action. They also show up in large airplanes, ambulances, medical vehicles of all kinds, and can even be purchased for home use. See Figure 1.

By contrast, standard external types of defibrillators require a trained EMT, or other medically trained person to operate. This person needs to be able to carry out the diagnostics, manually set charge levels, and time the pulse train if additional shocks are necessary. Standard defibrillators are usually much larger than AEDs, and typically found only in hospitals.

The portable battery-powered AED is approximately the size of a textbook. The unit contains two adhesive sensors joined by power lines to the main unit. (See Figure 2). An AED is similar in concept to manual defibrillators found in hospitals, but has been designed for use by people who have never used or operated one before, or never had any medical training. Units are labeled so that they can even be operated by users who can't read.



Defibrillator shown shocking patient with no heart rhythm



Defibrillator has restored normal heartbeat

Once activated, the unit typically verbally walks users through the setup and operational process, providing audio voice commands to guide the user through proper alignment of the sensors, power activation, and shock procedures. AEDs are totally self-diagnostic; once connected to a patient, the AED sensors analyze heart rhythm to determine if a shock is necessary. If the AED detects ventricular fibrillation, ventricular tachycardia or a non-beating heart, a high voltage shock is usually initiated.

This shock sends a high voltage and current pulse across the heart to shock the heart back into operation. Sometimes, repeated shocks are required before the heart starts operating again. If repeated shocks are necessary, a charging circuit in the defibrillator is activated to supply the next power burst. This charging circuit needs to be switched in and out in a reliable manner, in a guaranteed fault-free mode, to ensure proper recharging.

Reed relays provide battery-operated AED with high reliability, low power electronics

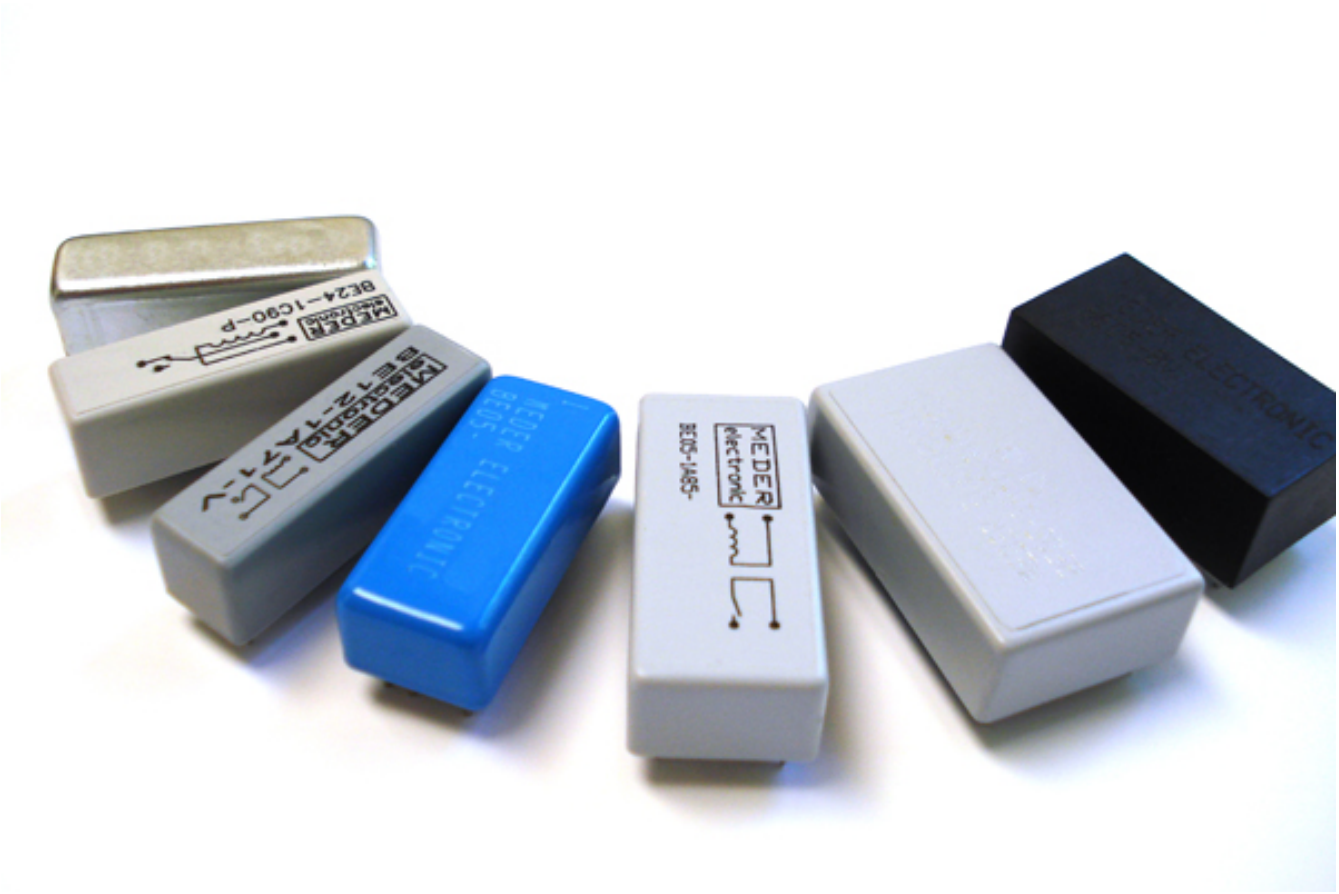
Since the portable AED is battery-operated, the electronics used to run the charging circuit must have a low average power use. The circuit must also contain very high reliability components. The reed relay is an excellent choice for switches used in portable battery operated defibrillators because it can operate reliably over a wide temperature range, and can also carry out billions of switching operations, making it an economical choice as well.

Early portable defibrillators used a single high voltage pulse and had a 60 to 70 percent success rate on heart stabilization. Newer models produce both a positive and negative pulse that has 95+ percent success rate on the first try. Like most equipment, increased usage led to competition, which has resulted in huge improvements. Reliability has risen dramatically; early components had high failure rates because they were unable to work in the rough environments of a rescue vehicle, or couldn’t be exposed to other abusive environments.

For example, the reed relay replaced an electromechanical relay, which had been used in most early versions of portable AEDs. Since the AEDs may be sitting for weeks, months, and sometimes years before being called upon to operate, they must work reliably the first time. The electromechanical relay’s lack of a hermetic seal allowed moisture, dust and dirt to eventually collect on the contacts, resulting in erratic or unreliable switching.

By contrast, high voltage reed relays offer the reliability needed for such an environment. Hermetically sealed high voltage reed switches are packaged in an epoxy sealed package, which offers all the protection needed in difficult environments. See Figure 3.

Any equipment that is truly portable must contain its own power source, so it is especially important that portable defibrillators use very low power consumption electronics. This is particularly true for battery-powered portable AEDs. For example, manufacturers’ instruction manuals specify that the AED device be regularly calibrated. Every time these calibrations and self-diagnostics are carried out, some power is used, resulting in some loss of battery energy. Using power-frugal components minimizes this battery drain.



To develop this type of reliable, low power consumption portable AED, MEDER electronics' engineers, for example, worked jointly with the engineers of several large device OEMs on the crucial charging circuit, conducting life tests, and developing circuit configuration, component selection and the relay contact configuration. The reliable high voltage reed relays are now designed into numerous new portable AED models.

The relay design is a two-pole normally open relay that has a special spacing between the switches and coil to maintain a long path length, thereby insuring a guaranteed high isolation voltage between the coil and the switches. The design uses no internal solder joints on the reed switches to ensure switching reliability. The reed switches are selected to withstand 4000 V minimum across the open contacts. The contacts can also switch up to 1000 V. MEDER's reed relays use hermetically sealed reed switches that are further packaged in high strength plastic, and can therefore be subject to various environments without any loss of reliability.

Reed relays ideal for high voltage switching in other medical equipment

Reed relays are routinely selected for use in medical equipment. For example, the high voltage reed relays are used in equipment that supplies high frequency and high current to cut and cauterize in an operating room environment. This is considered to be a clean, simpler method for surgical operations, eliminating blood flow into the critical area of focus. Operating rooms in the U.S. use the high voltage reed relay for 98 percent of all surgeries, with similar percentages in European countries.

With the continued increase of electronics in medical equipment, it is only a matter

of time before entirely new applications requiring high voltage switching will surface – reed relays are standing by as the design-in choice.

References

Definition of Automated External Defibrillators, http://www.ehow.com/facts_5977386_definition-automated-external-defibrillators.html, retrieved March 29, 2012.