Chapter 38 of the Society of Broadcast Engineers

SBE

EL PASO - LAS CRUCES - JUAREZ

AUGUST 2014

PO Box 3561 El Paso, TX 79923-3561 www.kint98.com

NEWS

AUTOMATED EXTERNAL DEFIBRILLATORS (continuation)

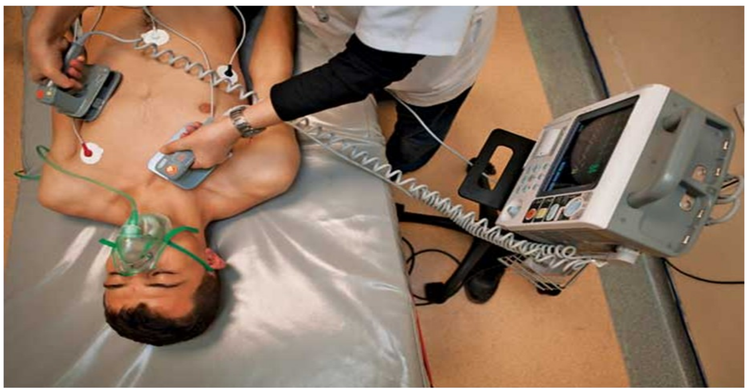

FIG.1- A hospital-style defibrillator uses paddles. Note that there is an external ECG or heart monitor on the patient, as evidenced by the white circles (electrodes) and leads (wires) on the chest.

Automated external defibrillators (AEDs) are designed to be used by members of the public with minimum training *(Fig. 2)*. These disposable electrode patches serve two purposes: first, monitor the heart with an ECG; and second, apply the high-voltage shock.

The AED protects its own input from the high voltage and current shock because it knows when it is about to apply the shock. Therefore it can, and does, disconnect the ECG monitor during the shock. The hospital-style defibrillator, however, is often used with a separate ECG or monitor. The ECG or monitor has no advanced warning and must withstand the high voltage and current of the shock.

FIG.2 Chest compression CPR (left) circulates blood to deliver oxygen to the brain and other vital organs until the heart can be restarted by the AED (right).

NEWS CONTINUES IN PAGE 2

Protecting The Defibrillator For ECGs

The voltage produced by a hospital defibrillator might be 3 to 5 kV at 50 A. A defibrillator test set looks very much like the standard ESD test set *(Fig. 3)*.[3] There is, however, an important difference. The ESD test has a capacitor measured in pico-farads, but the defibrillator test set is in many microfarads. So, the extra energy from the defibrillator must be dissipated in front of the ECG.

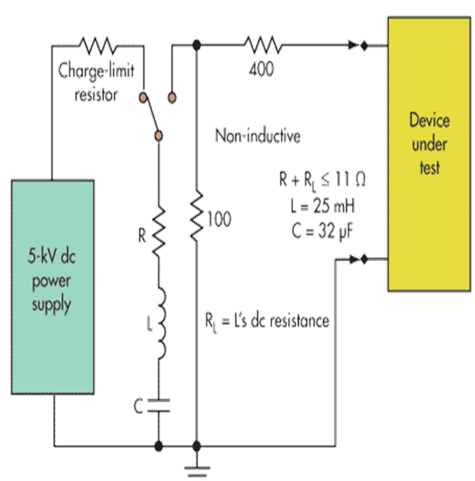

FIG.3 While a defibrillator test set looks like a standard ESD test set, it is measured in microfarads, not pico-farads.

Figure 4 shows a defibrillator's typical protection circuitry for an ECG. For convenience, we labeled the components in the left arm (LA) input circuit at the top. The normal ECG waveforms are on the order of a few (0.5 to 7 mV) millivolts, but the high-voltage defibrillator is in kilovolts and can last 5 to 20 ms, which is a long time for electronic components to survive such high voltage.

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EL PASO, TX CHAPTER 38 MEETING MINUTE
DATE 07/15/2014 LOCATION: LOS ARRIEROS REST.

MEETING CALLED TO ORDER: 12:24 PM, BY ANTONIO CASTRO, THERE WERE 16 MEMBERS

REPORT OF THE SECRETARY: MINUTES ACCEPTED BY LAWRENCE MONTENEGRO, 2nd BY CARLOS SOSA.

REPORT OF THE TREASURER: CURRENT BALANCE OF $ 5,494.44. SPENT $ 1,769.34 OUR SHARE FOR 2014 ENNES WORKSHOP. ACCEPTED BY OWEN SMITH, 2nd BY ELIAS VENTANILLA.

REPORT OF THE CERTIFICATION COMMITTEE: NO REPORT.

REPORT OF THE MEMBERSHIP COMMITTEE: NO REPORT.

REPORT OF THE FREQUENCY COORDINATOR COMMITTEE: CLEAR CHANNEL DAVID GRICE USED SOME FQCIES FOR TESTING DURING 2 WEEKS PERIOD.

REPORT OF THE SCHOLARSHIP COMMITTEE: NO REPORT.

REPORT OF THE WEBSITE COMMITTEE: 1692 HITS LAST REPORT, NOW 1709 (17 MORE FROM LAST MONTH).

REPORT OF THE EAS CHAIRMAN: OWEN SMITH REPORTED THAT MONTHLY TEST FROM NEW MEXICO DIDN'T SHOW COUNTIES.

REPORT OF THE PROGRAM COMMITTEE: JOHN BISSET, FROM TELOS WILL INVITE FOR US MARY ANN SEIDLER, TIELINE TECHNOLOGY FOR AUGUST.

UNFINISHED BUSINESS: NONE

NEW BUSINESS OR ANY ITEMS FOR THE CHAPTER INTERES: NONE

NEXT MEETING DATE AND LOCATION: AUGUST 12th, 2014, 12:00 PM (NOON) at ARRIEROS MEXICAN BUFFET, 4151 N. MESA

MEETING ADJOURNED: AT 13:42 PM.

Note from the EDITOR: **KDBC HAS 3 TECHNICAL OPENINGS, ONE FOR CHIEF ENGINEER AND TWO FOR BROADCAST ENGINEER.**

IF YOU ARE INTERESTED, GO TO THIS SITE:

https://sbgtvcareers.silkroad.com

AUGUST PROGRAM

We had a great presentation in July, thanks to John Bisset from TELOS-ALLIANCE, and the lunch was unique: Mexican buffet.

At the moment of publishing this newsletter, we didn't have a confirmation for our AUGUST presenter, so let's have our regular chapter meeting. In case that we find another presenter, it will be posted.

Meeting will be held at the "los arrieros" Mexican buffet @ 4151 N. Mesa (The Mesa Inn) this coming Tuesday the 12th of August at lunch time.

See you there !!

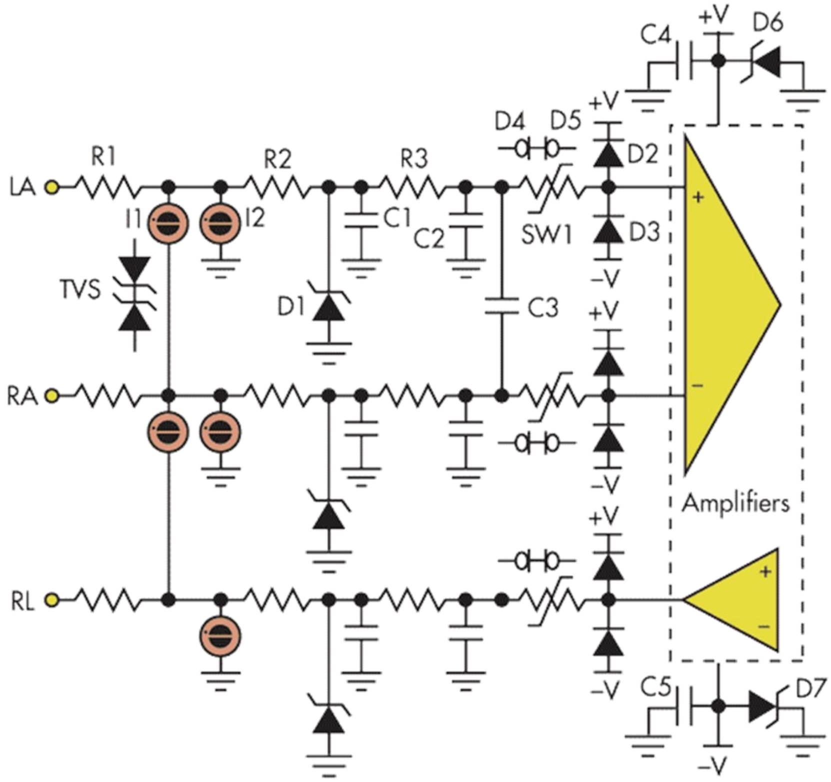

FIG 4 -Typical ECG front-end defibrillator protection circuitry must be able to handle kilovolts for 5 to 20 ms, which is a long time for electronic components. (LA = left arm; RA = right arm; RL = right leg)

Most ECG front ends use neon glow lamps such as the NE-2 or NE-23 (I1 and I2) for protection. A small radioactive dot inside the NE-23 provides photons to stabilize the ionization voltage. Alternatives for the neon lamps include gas-discharge arrestor tubes and transient voltage suppressors (TVSs).

Resistor R1, in the range of 10 to 20 kΩ, can be in the input of the amplifier or built into the cables. It is the series element that limits the current in the neon lamps. Resistors R2 and R3, along with capacitors C1, C2, and C3, form lowpass filters. The D1 diode limits the voltage to a lower level. D1 can be a zener or avalanche diode, a metal-oxide varistor (MOV), or a thyristor surge protector. The D1 capacitance in conjunction with C1 is part of the lowpass filter.

Capacitor C2 is the common-mode filter, whereas C3 provides differential filtering. Typically C3 is about 10 times larger than C2. SW1 is a high-voltage signal-line protector: a switch that senses high-voltage, turns off the series switch, and turns on a clamp to reduce the amount of voltage at the amplifier. SW1 can be replaced by a current-limiting diode that looks like a JFET with the source and drain terminals tied together.

Diodes D2 and D3 are ESD-protection (electrostatic discharge) diodes that clamp the amplifier input to the power supplies. Notice C4 and zener diode D6 at the top of the amplifiers. They absorb and clamp the positive voltage rail. C5 and D7 do the same for the negative power rail.

Nothing is perfect, though. This ECG defibrillator protection circuitry involves tradeoffs between how well the amplifiers are protected and the frequency response necessary for the ECG to function properly. The capacitance of the protection devices is critical to preserve the wanted heart frequency response. Repeated defibrillator shocks can degrade the input devices. The electrode degradation can contaminate the neon lamps, and the defibrillator's glass envelope can break to allow air and water into the lamp. Consequently, most manufacturers recommend replacing the input protection devices at least annually. In a hospital setting where the ECG and defibrillator are used frequently, they receive more shocks and will degrade even faster.

Now we must consider the effects of ESD as well as radio frequency interference (RFI), electromagnetic interference (EMI), and susceptibility (EMS) on this protection design.[4] The devices in Figure 5 fall into three categories:

cont. in p.6

• Voltage-limiting devices: gas discharge arrestors, MOVs, suppressor diodes, triacs, diacs, and switches
• Current-limiting devices: fuses, circuit breakers, and thermal cutouts
• Risetime reducers: resistors, inductors, coils, ferrite beads, and capacitors, all of which slow the risetime of a transient and, thereby, allow time for other protection devices to function

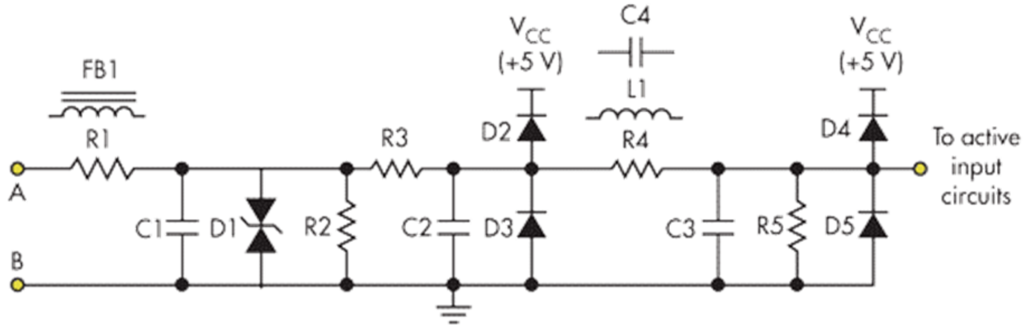

FIG. 5 -Today's defibrillator designs must protect against unwanted electrical vulnerabilities such as ESD, EMI, EMS, and RF

Capacitors are used with the resistors, ferrite beads, and inductors to act as lowpass filters. This approach controls the anti-alias filtering for the data converter. It slows the ESD risetime by spreading the impulse over time and allows the capacitors to be more effective.

The working voltage, equivalent series resistance (ESR), and self-resonance point of each capacitor need to match the application's frequency and bandwidth. The self-resonance point may mean that several smaller resistors are necessary in parallel to absorb the fast risetime of ESD and a defibrillator shock pulse.

Each of these networks is reciprocal. They protect a system from the outside world and protect the outside world from any unintentional signal that a device might radiate.

All of these devices can aid the ECG's protection circuitry. As this is becoming a complex system, it is wise to simulate it. Free and low-cost calculators[5] and simulators[6] are available for this task.

The Ultimate Goal Is Patient Protection

There have been many studies concerning the safe current levels impressed across the heart. The standards for medical equipment have bounced around, and today safe levels are less than 4 to 10 μA. This makes the design of medical equipment very demanding with extremely tight margins. Remember too that it is not uncommon to have several pieces of equipment attached to the patient at the same time. The total leakage current, then, must remain below the threshold that can harm the patient's heart.

With lives in the balance, a designer of defibrillators must understand the entire gamut of possible input protection methods and then choose the best defense at a reasonable cost. Patients must always be protected, which will include proper inspection and calibration of the equipment during the equipment's lifetime in the medical environment.

ANY SIMILARITY OR RESEMBLANCE WITH OUR PROFFESSION IT IS MERELY COINCIDENTAL !!!