ZOLL AED 3®

Service Manual

9650-000751-01 Rev. F

ZOLL®

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Preface

The ZOLL AED 3™ defibrillator is an Automated External Defibrillator (AED) that can be used for both adult and child victims of sudden cardiac arrest. The defibrillator incorporates a sequence of audio and visual prompts to help rescuers follow established AHA/ERC/ILCOR Guidelines for use of AEDs.

The *ZOLL AED 3 Service Manual* is to be used primarily by the ZOLL® Technical Service Department in conjunction with the *ZOLL AED 3 Operator's Manual* and the *ZOLL AED 3 Administrator's Guide*. The ZOLL AED 3 defibrillator does not require preventative maintenance due to its automatic self tests. However, this manual provides optional maintenance tests you can perform periodically according to local protocols.

This manual contains the following sections:

Preface—Contains safety warnings and an overview of the manual's contents. Review this section thoroughly before attempting to use or service the ZOLL AED 3.

Chapter 1—Maintenance provides the recommended procedures for evaluating the condition and performance of the ZOLL AED 3 defibrillator.

Chapter 2—Troubleshooting describes possible problems and solutions and lists the error log messages that indicate the AED requires technical service.

Chapter 3—Functional Description provides technical descriptions of the ZOLL AED 3 defibrillator modules.

Appendix—Hardware/System Architecture contains a diagram of the ZOLL AED 3 hardware/system.

Checklist—Located on the back page of this manual and used to record the results of the maintenance tests in Chapter 1.

Conventions

Throughout this document, text prompts and voice prompts are indicated by capital italicized letters, such as *CALL FOR HELP*.

WARNING! Warning statements describe conditions or actions that can result in personal injury or death.

CAUTION Caution statements describe conditions or actions that can result in damage to the defibrillator.

NOTE Notes contain important additional information on servicing the defibrillator.

Safety Considerations

Only qualified personnel should service a ZOLL AED 3 defibrillator. Before using this defibrillator, read the ZOLL AED 3 Operator's Manual. Before servicing any equipment, review these safety considerations and read this manual carefully.

WARNING! The ZOLL AED 3 defibrillator can generate as much as 2250 volts with sufficient current to cause lethal shocks.

Before discharging the defibrillator, warn everyone near the equipment to *STAND CLEAR*.

Do not recharge, disassemble, or dispose of the battery in fire. The battery might explode if mishandled.

Chapter 1
Maintenance

The ZOLL AED 3 defibrillator automatically performs functional testing during periodic self tests. However, this chapter provides optional maintenance tests you can perform periodically according to local protocols. The following tests and maintenance instructions are included in this chapter:

- Self Tests
- Cleaning
- Manual Maintenance Tests

Self Tests

The ZOLL AED 3 defibrillator performs the following self tests to verify AED integrity and its readiness for emergency use:

- Battery Installation
- Power On
- Manual
- Automatic (Daily or Weekly, based on configuration)
- Automatic Monthly

AED Passed Self Test

Following successful completion of all self tests, the status indicator displays a green check (✓) to show that all tests passed and that the AED is ready to use.

AED Failed Self Test

If the status indicator is blank following the completion of any self test, the ZOLL AED 3 defibrillator is not ready for use and may be defective. Remove the

AED from service and consult the section "Chapter 2 Troubleshooting" on page 17 to help determine the problem.

Self Test Functions

The following functions are verified during self tests. Table 1 on page 5 lists the functions that are included in each self test.

- **Battery Capacity**: Verifies that the battery usage indicator shows adequate battery capacity remaining.
- **Defibrillation Pads Connection**: Verifies that the defibrillation pads are properly preconnected to the device.
- **Defibrillation Pads (CPR Uni-padz™)/Battery Expiration Verification**: Verifies that the defibrillation pads are within their expiration date and the battery is within its install-by date.
  Note: CPR Uni-padz are the only electrodes that have an expiration date that is recognized by the ZOLL AED 3 device.
- **ECG Circuitry**: Tests that the ECG signal acquisition and processing electronics are functional.
- **Defibrillator Charge and Discharge Circuitry**: Verifies that the device's defibrillator electronics are functional and can charge and discharge at 2 joules. The following tests also include a separate 200 joule charge/discharge test: Battery Installation Self Test, Automatic Monthly Test.
- **Microprocessor Hardware/Software**: Verifies proper function of the AED microprocessor electronics and the integrity of its software.
- **CPR Circuitry and Sensor**: Determines that CPR monitoring and compression depth detection are functional (if defibrillation pads with CPR functionality are connected).
- **Audio Circuitry**: Verifies that voice prompts are working.

Automatic Self-Test Transfer

All ZOLL AED 3 defibrillators come standard with Program Management Onboard™ intelligent monitoring technology to transfer self-test data. If configured, the AED can automatically transfer self-test information over Wi-Fi to the ZOLL PlusTrac™ AED program management system or to another AED program management provider.

Table 1: Self Test Functions

	Battery Installation Self Test	Power On Self Test	Manual Self Test	Automatic Self Test	Auto-matic Monthly Test
Battery Capacity	✓	✓	✓	✓	✓
Defibrillation Pads Connection	✓	✓	✓	✓	✓
Defibrillation Pads (CPR Uni-padz)/ Battery Expiration	✓	✓	✓	✓	✓
ECG Circuitry	✓	✓	✓	✓	✓
Defibrillator Charge and Discharge Cir-cuitry (2 Joule Charge/ Discharge Test)	✓	✓	✓	✓	✓
Microprocessor Hardware/Software	✓	✓	✓	✓	✓
CPR Circuitry and Sensor (if defibrilla-tion pads with CPR functionality are con-nected)	✓	✓	✓	✓	✓
Audio Circuitry	✓	✓	✓	✓	✓
200 Joule Charge/ Discharge Test	✓				✓

Cleaning the AED

After each use, clean and disinfect the defibrillator with a soft, damp cloth using either 90% isopropyl alcohol, or soap and water. You can also use a chlorine bleach and water mixture (30 ml/liter water) to clean the defibrillator (except on the contacts and connectors).

NOTE Wipe down the defibrillator with water after using any cleaning solution. Chlorine residue that remains on the LCD screen may cause damage.

DO NOT:

- Immerse any part of the defibrillator in water.
- Use chlorine mixture on contacts or connectors; this will degrade the contacts over time.
- Use ketones (MEK, acetone, etc.) to clean the defibrillator.
- Use abrasives (e.g., paper towel) on the display window or graphic screen.
- Sterilize the defibrillator.

Manual Maintenance Tests

This section provides instructions for performing a physical inspection of and maintenance tests on the ZOLL AED 3. The maintenance tests verify that the AED is working properly and is ready for use. Use the checklist on the back page of this manual to record the results (pass/fail rating) of these maintenance tests.

Physical Inspection Test

	Check the following:	Pass/Fail
HOUSING		
1.	Is the AED clean, undamaged, and free of excessive wear?	o o
2.	Does the handle work properly?	o o
3.	Are input connectors clean and undamaged?	o o
4.	Are there any cracks or loose parts in the housing?	o o
5.	Does the front panel/display have any damage or cracks?	o o
ELECTRODES		
6.	Is the cable free of cracks, cuts, or exposed or broken wires?	o o
7.	Are the defibrillation pads connected to the AED and sealed in their package? Replace defibrillation pads if expired.	o o
BATTERY		
8.	Is the battery correctly seated in the battery well?	o o
9.	Is the battery housing free of cracks and damage?	o o
10.	Are the connectors free of damage and excessive wear?	o o
11.	Is the battery pack within the install by date? Replace if the install by date has passed.	o o
GENERAL		
12.	Turn on the AED and verify the green check (✓) indicates ready for use; then turn it off.	o o

Test Equipment

The following is a list of equipment that you need to perform the maintenance tests in this chapter. You can substitute an equivalent device for a listed device; however, not all simulators and analyzers will produce the same results. Be sure to follow the manufacturer's recommendation for conducting the maintenance tests.

- Fluke Impulse 7000 Defib Analyzer (or equivalent)
- Stopwatch
- ZOLL AED 3 Uni-padz Defib Test Cable Kit (**REF** 8900-000268)
- Blank USB Flash Drive (minimum 512 MB, USB 1.1 or 2.0 compliant)
- Computer (Wi-Fi capable with ZOLL RescueNet® software loaded and speakers if testing audio recording)
- ZOLL AED 3 Battery Pack
- Battery Test Fixture (**REF** 9100-000369-TF) (optional)
- Power Supply 10A
- Digital Multi-Meter (Agilent 34401A or equivalent)
- Wi-Fi Access Point

NOTE If the Battery Test Fixture is not available, the tests in this section can be conducted with a ZOLL AED 3 Battery Pack.

Power Supply Test (Optional)

This test is comprised of two tests: the Off Current test and the On Current test. In order to perform the Off Current test, two measurements are required: one with the fixture installed in the device and one for the test fixture. The difference of the two readings is the Off Current Value.

NOTE If a Power Supply is not available for this test, record N/A for this test on the Maintenance checklist on the back page of this manual.

Equipment Needed

Battery Test Fixture, Power Supply, Digital Multi-Meter.

Set Up

1. On the Digital Multi-Meter, set the function to DC Amps.
2. Connect the positive lead from the I jack to the positive current post (Amp meter) on the Battery Test Fixture.
3. Connect the negative lead from the LO jack to the negative current post on the Battery Test Fixture.
4. Set the Power Supply to 12.0V, then turn it off.
5. Connect the leads from the Battery Test Fixture to the proper polarity of the Power Supply and install the Battery Test Fixture into the battery well.

	Action	Expected Result(s)	Pass/Fail
1.	Turn on the Power Supply.	Verify that the AED runs a self test (approximately one minute) and then powers off. **Note**: AED may issue the messages *CHANGE BATTERY* and *UNIT FAIL*. Disregard the messages and continue the test.	o o
2.	Verify that the AED is turned off to perform the Off Current test. On the Battery Test Fixture, turn the I Measure switch to the sleep mode position. After the measurement is taken, turn the I Measure switch back to the off position.	Write down the current measurement on the Digital Multi-Meter. Value #1_____mA	
3.	Remove the Battery Test Fixture from the unit. Turn the I Measure switch to the sleep mode position. After the measurement is taken, turn the I Measure switch back to the off position.	Write down the current measurement on the Digital Multi-Meter. Value #2_____mA	

	Action	Expected Result(s)	Pass/Fail
4.	Subtract Value #2 from Value #1. This is the device Off Current Value.	Verify that the value is between 004mA and 0.015mA.	o o
5.	Press the On/Off button on the AED to turn it on to perform the On Current test.	Verify that the AED powers on in Rescue Mode. **Note**: The AED may issue the *CHANGE BATTERY* message. Disregard the message and continue the test.	o o
6.	On the Battery Test Fixture, turn the I Measure switch to the sleep mode position. After the measurement is taken, turn the I Measure switch back to the off position.	Observe that the current measurement on the Digital Multi-Meter is between 200mA to 440mA.	o o
7.	Press the On/Off button on the AED to turn it off.	Verify that the AED issues the prompt *UNIT POWERING OFF*.	o o

Pediatric Mode Test

Equipment Needed

Power Supply, Battery Test Fixture, Defib Test Cable, Fluke Impulse 7000 Defib Analyzer (or equivalent).

NOTE The test values in the following procedure are based of the default pediatric energy settings (50, 70, and 85 joules) into a 50 ohm load. If the Analyzer you are using has a different impedance value, refer to the table "Delivered Energy at Each Defibrillator Setting into a Range of Loads" on page 13.

Set Up

Connect the Defib Test Cable to the Defib Analyzer, and set the waveform to VFIB.

	Action	Expected Result(s)	Pass/Fail
1.	Connect the ZOLL AED 3 Uni-padz Defib Test Cable Kit to the AED, then press the On/Off button to turn on the AED.	Verify that the AED issues the prompts *UNIT OK*, *ADULT PATIENT SELECTED* followed by *IF PATIENT IS A CHILD, PRESS CHILD BUTTON*.	o o
2.	Press the Child button.	Verify that the Child button LED illuminates, and that the AED issues the prompt *CHILD PATIENT SELECTED*.	o o
3.	(First shock energy test. First pediatric shock energy is 50 joules.)	Verify that the AED issues the prompt *DON'T TOUCH PATIENT ANALYZING*, followed by, *SHOCK ADVISED*, *DON'T TOUCH PATIENT*, and *PRESS FLASHING SHOCK BUTTON*.	o o
4.	Press the flashing shock button.	Verify that AED prompts *SHOCK DELIVERED*.	o o
5.		Verify that the energy delivered into analyzer is 43 joules to 58 joules.	o o
6.		Verify that the AED issues the prompt *START CPR*.	o o
7.	Press the On/Off button to turn off the AED.	Verify that the AED issues the prompt *UNIT POWERING OFF*.	o o

Energy Test

Equipment Needed

Power Supply, Battery Test Fixture, ZOLL AED 3 Uni-padz Defib Test Cable Kit, Fluke Impulse 7000 Defib Analyzer (or equivalent).

NOTE The test values in the following procedure are based of the default adult energy settings (120, 150, and 200 joules) into a 50 ohm load. If the Analyzer you are using has a different impedance value, refer to the table "Delivered Energy at Each Defibrillator Setting into a Range of Loads" on page 13.

Set Up

This test continues from the previous test. The ZOLL AED 3 Uni-padz Defib Test Cable Kit is connected to the Defib Analyzer, and the waveform is set to VFIB.

	Action	Expected Result(s)	Pass/Fail
1.	Disconnect the ZOLL AED 3 Uni-padz Defib Test Cable Kit from the AED, then press the On/Off button to turn on the AED.	Verify that the AED issues the prompts *UNIT OK* and *PLUG IN PADS CABLE*.	o o
2.	Connect the ZOLL AED 3 Uni-padz Defib Test Cable Kit to the AED.	Verify that the AED issues the voice prompt *ADULT PATIENT SELECTED,* followed by *IF PATIENT IS A CHILD, PRESS CHILD BUTTON*.	o o
3.	(First shock energy test. First adult shock energy is 120 joules.)	Verify that the AED issues the voice prompts *DON'T TOUCH PATIENT, ANALYZING*, followed by *SHOCK ADVISED*, *DON'T TOUCH PATIENT*, and *PRESS FLASHING SHOCK BUTTON*. **Note**: For Automatic models, instead of *PRESS FLASHING SHOCK BUTTON* the AED issues the prompt *SHOCK WILL BE DELIVERED IN THREE, TWO, ONE.*	o o
4.	Press the flashing shock button. **Note**: For Automatic models, the AED automatically shocks the patient.	Verify that the AED issues the prompt *SHOCK DELIVERED*. **Note**: For Automatic models, the AED discharges the charge.	o o
5.		Verify that the energy delivered into the analyzer is 100 joules to 135 joules.	o o
6.		Verify that the AED issues the prompt *START CPR*.	o o

	Action	Expected Result(s)	Pass/Fail
7.	Hold the CPR sensor (attached to the ZOLL AED 3 Uni-padz Defib Test Cable Kit) in the palm of your hand. Move your hand in front of you in an up and down motion of approximately 2 inches at a rate of 100bpm. (Conduct test for about 20 seconds.)	Verify that the AED displays the CPR depth compression indicator. **Note**: The ZOLL AED 3 BLS model only displays the CPR depth compression indicator when the display is configured for lay user.	o o
8.		Verify that the AED issues the prompt *STOP CPR* after 2 minutes (default setting).	o o
9.	(Second shock energy test. Second adult shock energy is 150 joules.)	Verify that the AED issues the voice prompts *DON'T TOUCH PATIENT, ANALYZING*, followed by *SHOCK ADVISED*, *DON'T TOUCH PATIENT*, and *PRESS FLASHING SHOCK BUTTON*. **Note**: For Automatic models, instead of *PRESS FLASHING SHOCK BUTTON,* the AED issues the prompt *SHOCK WILL BE DELIVERED IN THREE, TWO, ONE.*	o o
10.	Press the flashing shock button. **Note**: For Automatic models, the AED automatically shocks the patient.	Verify that the AED issues the prompt *SHOCK DELIVERED*. **Note**: For Automatic models, the AED discharges the charge.	o o
11.		Verify that the energy delivered into analyzer is 123 joules to 167 joules.	o o
12.		Verify that the AED issues the prompt *START CPR*; after 2 minutes (default setting), verify that the AED issues the prompt *STOP CPR*.	o o
13.	(Third shock energy test. Third adult shock energy is 200 joules.)	Verify that the AED issues the voice prompts *DON'T TOUCH PATIENT, ANALYZING*, followed by *SHOCK ADVISED*, *DON'T TOUCH PATIENT*, and *PRESS FLASHING SHOCK BUTTON*. **Note**: For Automatic models, instead of *PRESS FLASHING SHOCK BUTTON,* the AED issues the prompt *SHOCK WILL BE DELIVERED IN THREE, TWO, ONE.*	o o

	Action	Expected Result(s)	Pass/Fail
14.	Press the flashing shock button. **Note**: For Automatic models, the AED automatically shocks the patient.	Verify that the AED issues the prompt *SHOCK DELIVERED*. **Note**: For Automatic models, the AED discharges the charge.	o o
15.		Verify that the energy delivered into analyzer is 178 joules to 240 joules.	o o
16.	Press the On/Off button to turn off the AED.	Verify that the AED issues the prompt *UNIT POWERING OFF.*	o o

Table 2: Delivered Energy at Each Defibrillator Setting into a Range of Loads

Load	Selected Energy					
	50 J	**70 J**	**85 J**	**120 J**	**150 J**	**200 J**
25Ω	37 J	54 J	57 J	86 J	109 J	139 J
50Ω	50 J	69 J	80 J	118 J	145 J	209 J
75Ω	61 J	82 J	97 J	134 J	166 J	196 J
100Ω	60 J	84 J	95 J	142 J	165 J	194 J
125Ω	57 J	80 J	91 J	133 J	155 J	178 J
150Ω	65 J	91 J	103 J	124 J	145 J	192 J
175Ω	60 J	84 J	95 J	116 J	135 J	177 J
Accuracy	±15%	±15%	±15%	±15%	±15%	±15%

Wi-Fi Test

Equipment Needed

Battery Test Fixture, Power Supply, Wi-Fi Access Point.

NOTE To test the server connectivity, the AED must be connected to an access point. For more information, refer to "Setting up your Wireless Configuration" in the *ZOLL AED 3 Administrator's Guide*.

Set Up

- Set the Power Supply to 12 volts.
- Connect the Battery Test Fixture to the Power Supply.

	Action	Expected Result(s)	Pass/Fail
1.	Press and hold the On/Off button for more than 5 seconds to turn on the AED in AED Management (Non-Rescue) Mode.	Verify that the AED displays the Select Operating Mode window.	o o
2.	Press the Device Configuration icon ( ).	Verify that the AED displays the Configuration window.	o o
3.	Press the Supervisor icon ( ) and enter the six-digit passcode (default passcode is 123456) and press **OK**.	Verify that the AED displays the Advanced Configuration window.	o o
4.	Press the Wi-Fi icon ( ).	Verify that the AED displays the Wi-Fi Settings window.	o o
5.	In the **Device History Settings** field, select **Edit**.	Verify that the AED displays the Device History Settings window.	o o
6.	In the **Selected Access Point** field, choose an access point.		
7.	Press the **Test Wi-Fi** button.	Verify that the AED displays the *TESTING SERVER CONNECTIVITY* message along with the *IN PROGRESS* message.	o o
8.		Verify that the AED displays the message *TESTING SERVICE CONNECTIVITY, COMPLETE.*	o o
9.	Press the **OK** button, press **Cancel**, and then press **OK**.	Verify that the AED displays the Advanced Configuration window.	o o

USB Test

Equipment Needed

USB Flash Drive (Blank), Power Supply, Battery Test Fixture, computer

Set Up

This test continues from the previous test. The AED should display the Advanced Configuration window.

	Action	Expected Result(s)	Pass/Fail
1.	Insert the USB Flash Drive into the USB connector on the back of the AED.	Verify that the blinking USB device icon (•⇄) appears in the status bar at the bottom of the display screen. (The blinking icon switches to steady status.)	o o
2.	Press the Export Files icon ( )and select **Clinical Archives (all)**.	Verify that the green check appears next to the **Clinical Archives (all)** option.	o o
3.	Press **Save (USB)**.	When the transfer is complete, verify that the AED displays the message *DATA TRANSFER COMPLETE*.	o o
4.	Press **OK**, then press **Cancel**. Remove the USB Flash Drive.	Verify that the USB icon (•⇄) no longer appears in the status bar at the bottom of the display screen.	o o
5.	Press the On/Off button to turn off the AED.	Verify that the AED issues the prompt *UNIT POWERING OFF*.	o o
6.	Insert USB Flash Drive in the computer USB port. Open File Explorer, and select the USB drive.	Verify that there is at least 1 CRD file present. (The AED can store up to 2 CRD files.)	o o

Audio Recording Test (ZOLL AED 3 BLS models only)

If the defibrillator does not have audio recording functionality enabled, record N/A for this test on the Maintenance checklist on the back page of this manual.

Equipment Needed

USB Flash drive (containing Clinical Event data from the previous USB test), Power Supply, Battery Test Fixture, PC (with RescueNet Code Review version =>5.72).

Set Up

Audio recording must be set to ON; the default for this configuration setting is ON. Refer to the Configuration Settings in the *ZOLL AED 3 Administrator's Guide* if you need to change this setting to ON.

NOTE The ZOLL AED 3 BLS defibrillator (with the Audio Recording option) is capable of recording up to 120 minutes of continuous ECG/Audio and clinical event data during the rescue of a patient case.

	Action	Expected Result(s)	Pass/Fail
1.	Insert USB Flash Drive (containing the Clinical Event data from the previous USB test) in the computer USB port. Open File Explorer, and select the USB drive.	Verify that CRD files are present.	o o
2.	Double-click the desired file and then click **Yes** in the message box.	Verify that the RescueNet Code Review Standard Edition window appears.	o o
3.	Select *3-Magnified ECG* at the top of the screen and click **Play**.	Verify that you can hear all voice prompts and events (from the computer speaker) that were recorded by the AED.	o o
4.	Press the On/Off button to turn off the AED.	Verify that the AED displays the message *UNIT POWERING OFF*.	o o

Chapter 2
Troubleshooting

This chapter describes technical issues that you may encounter during routine maintenance or after a malfunction of the ZOLL AED 3 defibrillator.

Troubleshooting the AED

The following tables include common issues and their solutions. First, try the recommendations listed under “Operator Action.” If these steps do not remedy the problem, follow the suggestions under “Technical Action.”

Table 3. ZOLL AED 3 Troubleshooting

Problem	Operator Action	Technical Action
Green check does not appear in status indicator window.	Initiate manual self test by pressing and holding the On/Off button for more than 5 seconds.	If the AED continues to fail, remove it from service.
UNIT FAILED prompt	Initiate manual self test by pressing and holding the On/Off button for more than 5 seconds.	If the AED continues to fail, remove it from service.
Beeping noise when AED is off.	Verify that the defibrillation pads cable is properly plugged into the patient cable connector. Turn the AED off and then press and hold the On/Off button for at least 5 seconds to perform a self-test. Verify that a green check appears in the status indicator window.	If the AED continues to beep, remove it from service.
CHANGE BATTERY	Replace the battery pack.	If the message persists, remove the AED from service.
PLUG IN PADS CABLE	Ensure that the defibrillation pads cable is properly plugged into the patient cable connector.	If the message persists, remove the AED from service.
CHECK PADS	Reattach pads.	If the message persists, attach new pads.
ANALYSIS HALTED; KEEP PATIENT STILL	Keep the patient still during ECG analysis. If transporting the patient by stretcher or vehicle, stop all patient movement during analysis.	If the message persists, remove the AED from service.
NO SHOCK DELIVERED	The Shock button was not pressed or an internal error occurred. When prompted to press the button, do so within 30 seconds.	If an internal error occurred (no shock was delivered when the Shock button was properly pressed), remove the AED from service.
RELEASE SHOCK BUTTON	(Semi-automatic models only) Release the Shock button. Do not press the button until the charge-ready tone sounds and the button begins flashing.	If the message persists, remove the AED from service.

Table 3. ZOLL AED 3 Troubleshooting (Continued)

Problem	Operator Action	Technical Action
ATTACH CORRECT DEFIB PADS	Attach one of the following compatible defibrillation pads to the AED: • CPR Uni-padz • CPR-D-padz® • CPR Stat-padz® • Stat-padz II • Pedi-Padz® II	If the message persists, remove the AED from service.
REPLACE PADS	Attach new defibrillation pads to the AED.	If the message persists, remove the AED from service.

Chapter 3
Functional Description

This chapter contains functional descriptions of the components contained in all of the ZOLL AED 3 models. Refer to the Appendix for a diagram of the ZOLL AED 3 Hardware/System Architecture.

High Voltage Circuit Section

The high voltage circuit section is electrically isolated from the main battery and the USB port, and is referred to as the isolated side.

The high voltage section is controlled by the Micro-controller (MCU) and the Complex Programmable Logic Device (CPLD) in real time. The MCU gets instructions (commands) from the System on Module (SoM) (such as charge voltage for the high voltage capacitor, discharge schedule, discharge button state, etc.) and reports the high voltage section status (such as self-test results, raw ECG data, patient impedance, safe to charge, safe to discharge, etc.) through isolated communication channels.

Low Voltage Analog Circuit Section

Low voltage analog circuits exist both in the isolated and the non-isolated circuitry. Isolated functionality includes ECG, CPR, and battery monitoring. Non-isolated functionality includes audio playback and recording, and battery monitoring.

Digital Section

This section describes all the digital functions that the ZOLL AED 3 provides, including functions the SoM provides and functions the MCU/CPLD provide. This section also describes the clock circuit, RTC interface, audio I2S interface, I2C interface, switch interface, accelerometer interface, LCD/capacitive touch interface, Wi-Fi function, USB (host/device) functions and Readiness Indicator function.

Isolation

The ZOLL AED 3 provides isolation between applied parts (pads) and accessible parts (USB host/device and battery pack pins).

Circuits on system side (also referred to as non-isolated side) are:

- SoM (Including USB host/device, LCD, I2C for capacitive touch interface, inputs for power switch, shock switch)
- Battery pack
- Audio (speaker and microphone)
- Readiness Indicator display
- Flyback transformer primary side (signals: CHARGE, XEND_CYCLE, CHARGE_CURRENT)
- Power supply (non-isolated from battery pack)

Circuits on high voltage side (also referred to as isolated side) are:

- MCU
- CPLD
- ECG circuitry (acquiring ECG data, impedance data and patient lead on/off data)
- CPR sensor (including EEPROM with I2C, analog signal to a ADC channel on the SoM)
- Defib discharge
- Defib discharge current monitoring
- High voltage capacitor voltage monitoring
- Flyback transformer secondary side
- Power supply (isolated from battery pack)

Communication between the system side and the high voltage side:

- Serial port Universal Asynchronous Receiver/Transmitter (UART) on the SoM communicates with the MCU serial port (UART). Isolation is provided by a multi-channel isolator.
- High voltage capacitor charge signals and status between primary side and secondary side. (PATREL, BAT_SENSE, XEND_CYCLE, FLYBACK_DRV, and SAFE_1). Isolation is provided by a multi-channel isolator.
- Power supply from the main battery to the high voltage side. The isolation is provided by an isolated power transformer.

Readiness Indicator Board

The Readiness Indicator Board provides interconnection between the main board and the readiness status display, the power button, and the microphone.

USB Connection

The ZOLL AED 3 provides a USB host (mass storage device) connection and a USB device connection (PC) through a USB connector board.

Other External Connections

The ZOLL AED 3 provides pediatric switch, patient electrode/CPR connection and battery pack connections through additional connectors on the main board.

Safety Function

This section summarizes the safety function on ZOLL AED 3 architecture. The following is the list of the signals for safety functionality:

Signal	Description
Vcap1	Measurement of the high voltage capacitor voltage separate from Vcap2.
Vcap2	Measurement of the high voltage capacitor voltage separate from Vcap1.
ABORT	Signal that is connected to the input port of the CPLD.
SAFE_1	A digital output port from the MCU.
FLYBACK_DRV	A digital pulse output port from the CPLD.
PAT_REL	A digital output port from the CPLD.

Safety on High Voltage Capacitor Charge

- Two independent circuits monitor the high voltage capacitor voltage (Vcap1, Vcap2). This arrangement provides redundant measurement of high voltage capacitor voltage.
- If the measurements of Vcap1 and Vcap2 are different than a preset limit then the MCU/CPLD stops the charge and sends an error message to the SoM.
- The charge rate (how fast the high voltage capacitor is charged) is also monitored by the MCU via the measurements of Vcap1 and Vcap2. If the charge rate is faster than or slower than programmed limits then the MCU/CPLD stops the charge and sends an error message to the SoM.
- The high voltage capacitor voltage is also monitored by a comparator. If the capacitor voltage exceeds the preset value then the output of the comparator stops the charge immediately via the ABORT signal that is connected to the input port of the CPLD.

- The charge pulse is enabled by the SAFE_1 from the MCU and FLYBACK_DRV from the CPLD. Any single fault on MCU or CPLD does not accidentally charge the high voltage capacitor.
- The FLYBACK_DRV signal from the CPLD is designed as a pulse output (maximum pulse width is 5us) such that the FLYBACK_DRV will never keep the flyback transformer in charging state for more than 5us. Further, the CPLD design guarantees that the adjacent pulse of FLYBACK_DRV is at least 1us later.
- The charge current is also monitored by a comparator. If the charge current exceeds a preset limit, the comparator output activates the ABORT signal which immediately disables the charge of the high voltage capacitor.

Safety on Discharge

- The patient relay is controlled by both SAFE_1 (from the MCU) and PAT_REL (from the CPLD); the patient relay on/off state is also monitored by GPIO channels in the MCU and/or CPLD. Any single failure does not cause the patient relay to accidentally be turned on and thus prevents the patient from receiving an inappropriate shock.
- The discharge current is monitored by an Analog-to-Digital converter (ADC) channel in the MCU at all times. The discharge circuit is designed in such a way that current can be monitored during the entire discharge cycle.
- The discharge current is also monitored by a comparator. If the discharge current exceeds a preset value, the output of the comparator stops the discharge via XDEFIB_EN in the CLPD (when XDEFIB_EN is low, and the CPLD turns off IGBT and opens the patient relay).

Safety on Digital Circuits

- The SoM and MCU are clocked with 2 independent clock sources. The clock rate is verified by the serial communication channel between the SoM and MCU. Any single fault in the clock frequencies will cause the serial communication channel to fail.
- The CPLD is clocked via MCU clock output. There is a clock source inside the CPLD; the CPLD can check the MCU output clock with its internal clock. If these two clocks do not match each other, then the CPLD outputs a signal to the MCU to report a clock failure. Further, the MCU can send an error message to the SoM to report a clock error.

Power Supply

There are two power supplies - one is for the SoM (non-isolated, from battery pack) and the other one for the ECG/CPLD/MCU components (isolated from battery pack).

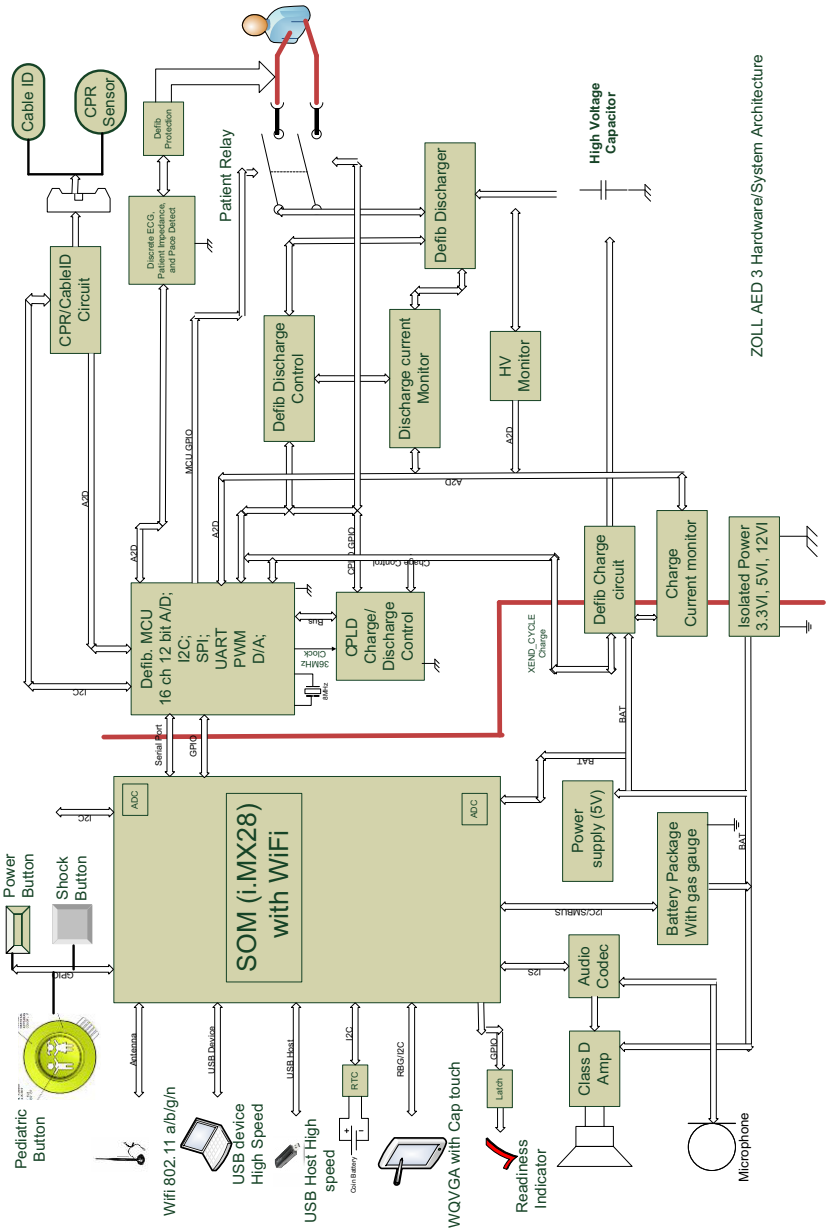
Power consumption in the monitoring mode is less than 5W (Ibattery < 350mA, typical).

Appendix Hardware/System Architecture

Overview

This appendix includes the Hardware/System Architecture diagram.

ZOLL AED 3 Hardware/System Architecture



Checklist

Overview

Use the checklist on the following page to record the results of the ZOLL AED 3 maintenance tests, and keep it for your records.

Result of Check:

o No action required
o Minor problems corrected
o Disposable supplies replaced
o Major problems identified (unit out of service)

Additional Remarks

_____

_____

_____

_____

_____

Serial Number: _____ Location: _____

Tester: _____ Signature: _____ Date: _____

ZOLL AED 3
Maintenance Tests Checklist

Physical Inspection Test

	Pass	Fail
1.	o	o
2.	o	o
3.	o	o
4.	o	o
5.	o	o
6.	o	o
7.	o	o
8.	o	o
9.	o	o
10.	o	o
11.	o	o
12.	o	o

Power Supply Test

	Pass	Fail	N/A
1.	o	o	o
4.	o	o	o
5.	o	o	o
6.	o	o	o
7.	o	o	o

Pediatric Mode Test

	Pass	Fail
1.	o	o
2.	o	o
3.	o	o
4.	o	o
5.	o	o
6.	o	o
7.	o	o

Energy Test

	Pass	Fail
1.	o	o
2.	o	o
3.	o	o
4.	o	o
5.	o	o
6.	o	o
7.	o	o
8.	o	o
9.	o	o
10.	o	o
11.	o	o
12.	o	o
13.	o	o
14.	o	o
15.	o	o
16.	o	o

Wi-Fi Test

	Pass	Fail
1.	o	o
2.	o	o
3.	o	o
4.	o	o
5.	o	o
7.	o	o
8.	o	o
9.	o	o

USB Test

	Pass	Fail
1.	o	o
2.	o	o
3.	o	o
4.	o	o
5.	o	o
6.	o	o

Audio Record Test

	Pass	Fail	N/A
1.	o	o	o
2.	o	o	o
3.	o	o	o
4.	o	o	o