Stone Technologies Corporation

Model 4110Dual Mode Battery Analyzer
Technical Manual

Contents

History and Design Overview

Stone Technologies Corporation (STC) has been the leader in self-powered battery load testers since the introduction of the Model 1209 in 1987. This product filled a need in the Fire and Security industry for a small, portable, self-powered battery load tester for use in the Fire and Security industry. This product was an instant success and became the de facto standard for testing 12 volt standby batteries up to a 12 amp hour capacity. In 1991, STC introduced the Model 612, which was essentially the same analyzer with the added ability to test6 and 12 volt batteries. In 2000, the Model 612-A was introduced which tested a wider range of battery sizes.

Over time it became apparent from discussions with Fire industry technicians, that they needed a tester to cover the whole range of battery sizes found in commercial Fire systems. Testers available at that time were outdated in technology and capability. Soon a new type of battery tester became available, using the measured internal resistance of the battery to determine the capacity of the battery. These testers were one-size-fits-all units that tested only 12 volt batteries and did not challenge the battery with any significant loading or discharge.

In 2003, STC began design on a combined load and internal resistance battery analyzer and gathered performance criteria from many of our customers. The resulting design is a dual mode analyzer that first tests the battery's response to a significant current loading for an extended length of time and then allows for a recovery period. Subsequently, it checks the internal resistance to determine the remaining amp hour capacity considering the variables of manufacturing construction, temperature, and other physical and chemical parameters that affect the total capacity of the battery.

Additional useful features include a voltmeter function to check the charging voltage and a math routine to calculate the minimum size of standby battery needed for a particular installation. The Model 4110 Dual Mode Battery Analyzer is the first tester to combine two types of battery analyses in a single instrument for the commercial Fire and Security industries. This device is computer controlled with an alphanumeric display for all operational prompting and results, a keypad for data input, and is powered from the battery under test. The unit is contained in an unbreakable waterproof carrying case with foam padding to provide the ultimate in protection under the most extreme conditions of transportation and storage.

Theory of Operation

The STC 4110 Dual Mode Battery Analyzer combines load testing and internal resistance calculation to provide a comprehensive analysis of the serviceability of a sealed lead acid battery. It can check either 6 or 12 volt batteries from 4AH to 110 AH on 12V and 4 AH to 60 AH

on 6V. The Analyzer is powered from the battery under test, requires no external power and has no internal batteries to replace.

When the battery for test is first connected, the STC 4110determines the voltage, 6 or 12, and displays it on a front panel LED. If the input voltage is outside the normal range, the unit will respond with a warning message to disconnect immediately. The battery should be disconnected from all equipment by removing the wires from one of the terminals. Failure to remove the battery from the circuit may result in damage to the charging circuit since the load testing will typically draw more current than the power supply can sustain.

The first test performed on a battery is the measurement of the terminal voltage, through Kelvin connections, while the battery is subjected to a significant load current. The load varies between approximately 2 amps and 35 amps, depending on the size of the battery. The Analyzer prompts for the entry of the amp hour rating (based on 20 hour discharge).Additionally, the temperature of the battery is entered to adjust the terminal voltage calibration. Based on the size of battery entered, both the time of the load test and the amount of current is set by the processor and the test initiates. A countdown timer is displayed showing the remaining seconds for the load test. A fundamental indication of the terminal voltage is given on the front panel LEDs: Good, Marginal, Bad. If at any time during the load test the terminal voltage drops below the acceptable minimum, the test will terminate early since there is no reason to continue testing a bad battery.

The second test measures the internal resistance of the battery. A short recovery time is allowed for the battery chemistry to stabilize after the load testing. This also serves as a cool-down period for the heat dissipating devices. The measurement of the internal resistance is used to calculate the theoretical remaining amp hour capacity of the battery. The battery temperature is used to adjust the results giving the remaining amp hours at room temperature (78 degrees F.). The measured amp hour value is displayed and compared to the rated amp hours to indicate the percentage of capacity remaining. It is not uncommon for newer batteries to show a capacity above the rated value.

At the end of the second test, the option is presented to calculate the battery size needed for a particular installation. By entering the current load and time for the standby condition and alarm condition, the STC 4110 will calculate the total amp hours of battery capacity needed without any allowance. You can then add a safety margin based on your own Company guidelines. A typical fire alarm system would have a 25-50%margin added to the calculated value. At this point the Analyzer can be disconnected and the testing is complete. The battery must be re-connected to the charging source and/or panel after testing.

Operation

This section details the steps for operating the STC 4110Analyzer. This is a summary of the operation depicted in the flow chart found at the end of this manual.

A. Connection to the Battery

The analyzer will test both 6 volt and 12 volt sealed lead acid batteries. It must not be connected to any other voltage level. Connection to any source above 15volts will result in an error message displaying "VOLTSTOO HIGH, DISC. IMMEDIATELY".

1. Disconnect one side of the battery from the equipment before testing as the load testing current may harm the charging circuits or set off a low voltage condition on the alarm system.
2. If the battery system consists of more than a single battery, then each must be tested separately. The batteries do not need to be disconnected from each other after the charging circuit is removed.
3. The red covered clip must be connected to the positive terminal.
4. The black covered clip must be connected to the negative terminal.

B. Load Test

1. The Analyzer will display a prompt to enter the amp hour rating of the battery. This is the 20 hour discharge rating for the battery. Enter a value between 4 and 110 amp hours.
2. The unit will then prompt for the entry of the battery temperature.
   a. Use the non-contact infrared thermometer included with the 4110 to measure the battery surface temperature.
   b. Enter the temperature within the range of 1 to 139 degrees Fahrenheit. If the temperature is 78 degrees or about room temperature, pressing the ENTER key will assume a value of 78. It's always better to measure the battery temperature since the power supply may raise the temperature of the alarm enclosure and thus the battery temperature.
3. Press the ENTER key to start the load test.
   a. The display will show a time remaining counter during the load cycle.
   b. During this time the battery will be subject to a current loading approximately equal to½ of the amp hour rating.
   c. On large batteries this discharge load consumes a considerable amount of energy from the battery which is converted into heat. Remove the Analyzer from the carrying case. One of the effects of this load is to remove any surface charge the battery may have developed from the charging voltage.

This surface charge makes any voltage vs. condition test unreliable. The result is determined at the end of the load test.

d. The heat sink on the back of the Analyzer has a large thermal mass as well as significant surface area to dissipate the heat. When testing a very large battery, over 60amp hours, allow enough time between tests for the heat sink to cool. The cooling time after the maximum size battery test will be about 10 minutes. The Analyzer can test batteries up to 20-30 amp hours without any additional cooling time other than that provided by the timing of the tests.

4. At the end of the countdown period, the display shows the basic ability of the battery to sustain a certain terminal voltage during the load test. This test is intended to uncover defects in the battery's structure, internal connections, and basic plate capacity due to chemical sulfating or erosion. A battery that fails this portion of the testing is patently unusable and should be replaced without further evaluation.

C. Recovery and Cool down

After a battery is discharged, the chemistry involved will change over time as it returns to equilibrium. At the start of the amp hour determination test a countdown timer is displayed that shows the remaining time allotted for the chemical recovery and Analyzercooldown. This time varies with the size of the battery being tested and is no more than 2 minutes. The amp hour determination test self initiates at the end of this interval.

D. Amp Hour Determination

The amp hour capacity that remains in any battery (not the rated capacity) is related to a mathematical calculation based on the measurement of the internal resistance of the battery and its mechanical construction. There are many variables that affect the actual remaining capacity, including temperature, age, physical construction, chemical deterioration of the plates, and depletion of the chemicals. Because all these factors, except the temperature, are difficult to define they must become a fixed part of the calculation. The 4110 Analyzer uses the average value for these variables and inputs the temperature of the battery, since it is the only variable easily measured. The resulting calculation for remaining capacity will be close to the value resulting from an actual discharge at a 20 hour rate.

When the ENTER button is pressed to start the dynamic amp hour determination and after the recovery and cool down time, the battery is subject to a precise, heavy, but short load while the terminal voltage is monitored. These readings are then

computed to the remaining empirical amp hours and displayed along with the percentage of rated capacity.

All testing is now complete and the resulting information can be used to determine the serviceability of the battery. The alternating display shows the results and instructs you to disconnect the battery or press ENTER to continue with a math routine to compare the required standby capacity to the measured capacity.

E. Battery Sizing Calculation

Calculating the required standby battery amp hours must be performed on all alarm systems to insure code requirements are met and specified minimum standby times are adequate during power fail conditions. Typically the technician does this by measuring the standby current consumption during a power loss and the alarm current draw during a power loss with the alarm activated. The Agency Having Jurisdiction (AHJ), the NFPA, or other government agency, usually mandates the amount of time required for both standby and alarm operation without AC power. The 4110Analyzer inputs these values and accurately calculates the size of battery needed for a particular system.

When you are prompted by the Analyzer, enter the values for the current (in milliamps) and time. The tester then compares the resulting minimum capacity to the calculated remaining amp hours. The result is displayed as adequate or replace. The required amp hours are also displayed to verify the sizing of the battery. A margin of25-50% should be allowed when using this minimum size to allow for battery deterioration and variations in charge state. This included routine eliminates potential sizing errors resulting from manual calculations.

Special Features

Several useful functions are included with the 4110Analyzer. These will assist the technician in completing a battery and charging system evaluation accurately and efficiently.

a. Voltmeter Mode

Immediately after connection to a battery, the Analyzer displays “STC DYNAMIC BATTERYANALYZER” for 2 seconds. During this time, pressing the ENTER key will place the system in voltmeter mode with a display showing the terminal voltage at the attachment clips. The measured source is subject to a200 milliamp loading as the Analyzer is powered entirely by the battery under test. This voltmeter mode is useful in determining the charging voltage when the power

supply is still connected to the battery. When subject to this 200 milliamp load, a smaller charging system may not show the true float voltage, especially if it is a series resistor regulated trickle charger. On larger systems, the charging system is less effected by this small load and will more accurately reflect the float charge voltage. At room temperature, a charge voltage of approximately 13.8 V is considered adequate to keep SLA batteries sustained near full charge. This "charged state" voltage varies significantly with the temperature of the battery. The variation in ideal charging voltage will be more than 2 volts between 32 and 130 degrees Fahrenheit.

After the voltage readings are complete, the Analyzer can be returned to normal operation by pressing the pressing the CANCEL key without disconnecting the clips.

b. Early Termination of Load Test

The load test may be terminated at any time during the countdown by pressing any key. This will set the countdown timer to 1 second. After the test results are shown, pressing the CANCEL key will restart the Analyzer as if it had just been connected to a battery. One reason for early termination may be the need to perform an amp hour calculation without including the load test. This is not; however, the recommended test procedure.

c. Early Termination of Amp Hour Recovery Time

The recovery/cool down phase of the test may be terminated early by pressing any key during the countdown. This will reset the timer to 1 second. Pressing the CANCEL key after the amp hour calculation results are displayed will restart the Analyzer as if it had just been connected to a battery. One reason for early termination is to obtain an approximate amp hour reading on a battery when the Analyzer heat sink is still cool. This is not; however, the recommended test procedure.

d. Infrared Thermometer

A non-contact infrared thermometer is included with the 4110 Analyzer to determine the actual battery temperature.

1. Pull the trigger switch to turn on the device and point the red laser dot at the battery.

2. Release the trigger and read the temperature on the display. This value will be entered when prompted at the start of the battery test procedure.

3. The infrared thermometer is battery operated and has a low battery warning which appears on the display. Under normal use, even taking 5-10readings a day, the battery will last for months.

4. A separate operating manual for the thermometer is stored in the Analyzer carrying case. The infrared thermometer is calibrated for“90% dark body” which means that it is most accurate when reading from a dark or black battery case. The error from reading a gray or other color battery is small and will not noticeably effect the test results.

e. Battery Sizing Calculation Routine

The battery sizing calculation is started by pressing the CANCEL key during the initial two seconds when the Analyzer display shows the “STC DYNAMICBATTERY TESTER” banner. The Analyzer can be rebooted at many points in the operation by pressing the CANCEL key to return to this banner.

A calculation of the needed standby battery amp hours must be performed on all alarm systems to insure that code requirements and minimum standby times will be met under power fail conditions. Typically you do this manually by measuring the standby current consumption during a power loss and the alarm current draw during a power loss with the alarm activated. The Agency Having Jurisdiction (AHJ), the NFPA, or other government agency, usually mandates the amount of time required. The 4110 Analyzer inputs these values and accurately calculates the battery size needed for a particular system.

The values for the current (in milliamps) and time are entered as prompted and the resulting minimum capacity is displayed to verify the sizing of the battery. A margin should be added when using this minimum size to allow for battery deterioration and variations in charge state. This included routine eliminates potential sizing errors resulting from manual calculations.

Specifications

Electrical

Input Voltage from battery: 5-15VDC, Auto-selects for 6V or 12V.

Testing Range: 4 to 110 Amp hour, 12V. 4 to 60 Amphour, 6V.

Load Current: aprox. 200 ma. during static test, 2-30 Amps max. duringdynamic test. Actual load is approximately 1/2 A.H. rating

Dynamic load time interval: 50-100 seconds. Aproximately 120 seconds max. for Amphourdetermination.

Mechanical

Size: 11.5” wide X 11” deep X 5” high.

Weight: 7.7 lb. analyzer, including test leads. 16.7 lbs. complete unit in case.(Shipping weight: 18 lb.).

Input Connection: Military Spec 97 Series Connector set.

Operating temperature: 32 to 140 degrees F. (0 to 50 degrees C.). 90% Relative humidity. Over temperature shutdown at 140 degrees F.

Battery Temperature Input: Non-contact infrared thermometer for reading; keypad entry for temperature.

Test leads: 48 inch, high flex instrumentation cable, Stranded, copper conductors with soldered connections. Heavy duty copper alligator clips with color coded vinyl insulating boots. Military grade connector assembly with strain relief boot.

GENERAL

Displays: Two Line vacuum florescent for prompts and data display. Five LEDs for battery voltage and load test results.

Data Input: 12 button keypad with vacuum florescent display for Amp hours, prompts, battery temperature, and data.

Warranty: Two years parts and labor. (See separate warranty statement for complete details.)

Replacement Parts

There are no user serviceable parts inside the 4110 Case. Any repairs other than replacement of the test cable assembly must be made by STC. A Return Materials Authorization number must be obtained before returning the analyzer for repair.

The following replacement parts can be ordered from your distributor:

Carrying Case with custom foam interior S T 3040

Test Cable Assembly ST 0307Quick Reference Card ST

Quick Reference card

Non-contact IR Thermometer ST IRT

Technical Manual ST Techman 4110

Call 800-440-1234 for ordering information.

Warranty Statement

Stone Technologies Corporation

Two Year Limited Warranty

1.What is covered: This warranty covers defects in materials and workmanship in this Stone Technologies equipment (“product”)with the exceptions noted below.

2.For how long: This warranty lasts for a period of two (2) years from the date you bought the Product from us or from one of our authorized distributors.

3.What we will do: We will repair or replace at our option, any Product that proves to be defective in materials and workmanship during the two (2) year warranty. This is your sole and exclusive remedy for any breach of warranty.

4.What is not covered: This warranty does not include any Product’s test leads, or external accessories. It does not extend to any Product which has been damaged as a result of accident, misuse, abuse (such as attempting to test other than the intended batteries, failure to follow the operating instructions that are provided by us, acts of God or other contingencies beyond our control), or as the result of service or modification by anyone other than us or our authorized repair facilities. Any implied warranties of merchantability or fitness for a particular purpose, are expressly denied. Some States do not allow limitations on how long an implied warranty lasts, so the above limit may not apply to you. We shall not in any case be liable for special, incidental, consequential, or indirect expenses, lost profits, or other similar damages arising from any breach of these warranties even if we have been advised of the possibility of such damages. Some States do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation may not apply to you. In no case shall our liability exceed the purchase price that you paid for the product.