

**Operating Instructions**  
**2406A Battery Analyzer**

# Contents

**Safety**

**Precautions**

**Terminology**

**Overview**

**What The Display Is Saying**

**Operating Instructions**

**Specifications**

## Safety

**Ground the product** This equipment is grounded through the ground conductor of the power cord. To avoid risk of electric shock plug the power cord into a properly grounded receptacle.

**Use the proper fuse** Use a fuse of the proper rating. 5x20mm, 4A, 250V.

**Do not operate in an explosive atmosphere** Breaking battery connections while servicing will cause arcing.

**Service specified chemistries only** Do not attempt to service alkaline or other non-rechargeable batteries.

**Do not service damaged batteries** Fire or explosion could result if service is attempted on a battery that is crushed, punctured or physically damaged.

## Precautions

Ensure battery specifications entered are correct for the battery being serviced. Incorrect battery information could result in damage to the battery.

Battery performance is effected by temperature. For best results service batteries at room temperature.

Do not service more than one battery pack at a time. Variation in capacity between batteries can result in overcharge or over discharge to the smaller battery.

# Terminology

**mAh** milli-Amp hour. The amount of current a battery can deliver for a period of one hour while maintaining its output voltage at a usable level. A milli-Amp is 1/1000 of an Amp. A good 1000 mAh battery can deliver 1 Amp for 1 hour and maintain its output voltage within the usable limit.

**C Rate** Capacity rate. The C rate is the 1 hour discharge current measured in milli-Amp hours. The 1C rate of a 1000 mAh battery is 1000 milli-Amps for 1 hour. The 2C rate is 2000 milli-Amps for ½ hour. The 0.1C rate is 100 milli-Amps for 10 hours etc...

**EODV** End Of Discharge Voltage. The voltage level too which the battery is discharged too.

## Overview

The 2406A battery analyzer can service the following battery types:

Nickel Cadmium	( NiCd )
Nickel Metal Hydride	( NiMH )
Sealed Lead Acid	( SLA )
Lithium-Ion	( Lith-Ion )

Battery sizes from 50 mAh to 60,000 mAh.  
Battery voltages from 1.2 Volts to 16.0 Volts.

### Program Functions Are:

**1 Charge** Charges the battery.

**2 Test** Standard Test - Tests battery using 1C discharge current and predefined EODV.  
Custom Test - Tests battery using user defined discharge current and EODV.  
Quick Test - Tests battery in 1 to 12 minutes. Determines if battery is good or bad.

**3 Renew** Restores NiCd and NiMH batteries to maximum capacity.

**4 Prime** Prepares new batteries for use.

# What The Display Is Saying

When a battery is being serviced the display goes into service mode showing four values. Ct and Va on the left side of the screen are the discharge results and C and V on the right side of the screen are the instantaneous capacity and voltage.

**Ct** is the Tested Capacity. The capacity discharged from the battery.

**Va** is the Average Voltage during discharge.

**C** is the instantaneous capacity when charging and discharging.

**V** is the instantaneous voltage when charging and discharging.

Values on the right side display the instantaneous values of C and V. The V stands for “Volts” and is the instantaneous battery voltage. The C stands for “Capacity” and shows how much charge has gone into or out of the battery. If the analyzer is charging C shows how much charge has gone into the battery. If the analyzer is discharging C shows how much charge has come out of the battery.

During a discharge C will equal Ct since both are showing the discharged capacity. An exception to this is when the analyzer is running the Renew cycle on a NiCd or NiMH battery. During the deep discharge portion of the program down to 0.5 Volts/Cell, Ct will remain fixed at the last discharge result while C will continue to increment slowly as more capacity is removed from the battery during the deep discharge phase.

After a discharge the CT and Va values will remain visible during the following charge cycle until the next discharge is performed. The CT and Va results are saved in memory and can be viewed anytime by stopping the service program and going to view results. Service will resume where it left off.

Ct=24%	C=24%
Va=6.8V	V=6.816V

**Display in “Service Mode”**

# Operating Instructions

Three battery parameters are needed for a battery to be serviced. The first three screens prompt the user for the chemistry, voltage and capacity. Ensure these parameters are correct for the battery being serviced. They will effect the charge and discharge rates. Miss-information could result in damage to the battery.

## Chemistry

The analyzer can service four chemistry types. Nickel Cadmium, Nickel Metal-Hydride, Lead Acid, SLA and Lithium-Ion. Do not attempt to charge chemistries other than those specified.

NiCd(1)	NiMH(2)
SLA (3)	Li-Ion(4) _

CHEMISTRY ENTRY SCREEN.  
Enter the battery chemistry.

- |   |                               |   |                      |
|---|-------------------------------|---|----------------------|
| 1 | Nickel Cadmium                | 2 | Nickel Metal-Hydride |
| 3 | Sealed Lead Acid or Lead Acid | 4 | Lithium-Ion          |

## Rated Voltage

The rated voltage of a battery is its nominal output voltage and a function of the number of cells in the pack. The voltage for Nickel Cadmium and Nickel Metal Hydride batteries is a multiple of 1.2 or 1.25 Volts per cell. Sealed Lead Acid and Lead Acid voltage is a multiple of 2.0 Volts per cell and Lithium-Ion battery voltage is a multiple of 3.6 Volts per cell.

Rated Voltage = _
-------------------

VOLTAGE ENTRY SCREEN  
Enter the rated battery voltage.  
Decimal point is automatically inserted.

## Rated Capacity

The rated capacity is the physical size of the battery measured in mill-Amp hours. Capacity range is 50 to 60,000mAh.

Rated Capacity = _
--------------------

CAPACITY ENTRY SCREEN  
Enter the milli-Amp hour (mAh) rating of the battery.

## Function

Select the function to be performed on the battery.

Note: The Renew function applies to Nickel Cadmium and Nickel Metal Hydride batteries only.

Charge(1)	Test(2)
Renew(3)	Prime(4) _

FUNCTION ENTRY SCREEN  
Select service requirement.

**Charge (1)** - Charges the battery. When complete NiCd and NiMH batteries remain on trickle charge. For Lead Acid and Lithium-Ion batteries no trickle charge is maintained. NiCd and NiMH batteries are slow charged until nominal voltage is reached. Fast charging commences once the battery reaches nominal voltage. If nominal voltage is not reached after 2 hours or 20% the charge cycle is terminated and the program moves to the next step.

**Test (2)** - Standard, Custom or Quick test.

**Standard Test** program cycle is Discharge, Charge, Discharge, Charge. The first discharge gives the residual capacity, followed by a charge, and the second discharge determines the full capacity followed by a full charge. The discharge cycle uses a user definable discharge current. The maximum is 1C or 6.25 Amps and the minimum is 25 mA. The end of discharge voltage for NiCd and NiMH batteries is 0.9 Volts/cell, SLA is 1.6 Volts/cell, and Lithium-Ion is 3.0 Volts/cell.

**Custom test** allows the user to select a test pattern, discharge current and end of discharge voltage. Test patterns to choose from are:

- 1 Discharge
- 2 Discharge-Charge
- 3 Charge-Discharge-Charge
- 4 Discharge-Charge-Discharge-Charge

User definable discharge current. Maximum is 1C or 6.25 Amps and the minimum is 25 mA. User definable EODV, multiple of 0.1 Volts between 1.0 Volt and the nominal battery voltage.

**Quick Test** takes 1 to 12 minutes depending on the state of charge and condition of the battery being tested. The "Quick Test" starts with a discharge at the 1C rate for a period of 80 seconds. If the battery can maintain a good voltage over this period it passes and the test is done. If not, the analyzer will perform a 5 minute charge to see if the battery can accept a charge properly. This period may not last the full 5 minutes if the battery can not accept the charge. This is followed by a second discharge test. If the battery does not pass the second discharge test another charge is applied for 5 minutes and a third and final discharge test is performed. If the battery can not maintain an acceptable voltage during the last discharge period it fails the "Quick Test" and it most likely has a bad cell.

**Renew (3)** For Nickel Cadmium and Nickel Metal Hydride chemistries. The renew cycle consists of a discharge followed by a charge and a second discharge after which if the battery fails to meet the target capacity a deep discharge is performed down to 0.5 Volts/cell. The deep discharge is done using short high current pulses spaced by rest periods to prevent cell reversal. The deep discharge dissolves crystalline formations in the battery that form during repeated overcharge. The deep discharge is followed by a complete charge. The instantaneous capacity “C” is then cleared to 0% and an additional 40% of charge is applied over 4 hours at the 0.1C rate to balance the cells. This is followed by a final Discharge-Charge cycle to determine the renewed capacity. Three results are saved for the renew cycle, C1=Residual capacity, C2=Capacity before renew and C3=The capacity after renew.

**Prime (4)** is used on new batteries or batteries that have been in storage for an extended period of time. The prime function exercises a battery by repeated discharge-charge cycles until it meets the target capacity or a maximum of four discharge-charge cycles. This eliminates the headache of initial short run times incurred with new batteries.

**Discharge Current** is used to control the rate of discharge. During repeated charge and discharge cycles some batteries may overheat. Overheating is dependent upon the enclosure or case of the battery and the arrangement of the cells within the pack whether they are packed into a bundle or laid out flat giving more surface area. Entering a lower discharge current generates less heat during discharge and gives a battery more time to cool during the discharge.

Discharge(mA) =  
 \_

DISCHARGE CURRENT ENTRY SCREEN  
 Enter the current you want the battery discharged at.

**Target** is used to determine a pass or fail criteria for a battery and if the deep discharge is required during the renew cycle or to terminate the prime cycle.

Target Capacity?  
 60→100% (1→5) \_

TARGET ENTRY SCREEN  
 Enter 1 to 5 to indicate 60 to 100% target capacity.

- |   |    |      |
|---|----|------|
| 1 | is | 60%  |
| 2 | is | 70%  |
| 3 | is | 80%  |
| 4 | is | 90%  |
| 5 | is | 100% |

**Connect** the battery and press enter ENT or backspace BKS to review. Reviewing your entries is a good practice before starting service to eliminate the chance of an error. During the service routine the BKS key can be hit at any time to pause service and review or change

entries or view results. When a battery is connected and the user hits the enter key the batteries connection and polarity are checked and bad connections or defective batteries are identified.

Connect Battery: ENT  
or BKS to Review

CONNECTION PROMPT SCREEN  
Hit enter to begin service, or backspace to view entries and test results.  
Battery connection, polarity and condition are checked at this time.

**Results** can be viewed at anytime during and after service. Up to four sets of discharge results are saved depending upon the service program being performed. Results for two batteries can be saved in memory at one time. If a third battery is serviced the results from the second battery are stored over top of the previous and the current memory area is cleared for the next battery. Results are stored for discharge capacity and average discharge voltage.

Service Battery(1)  
View Results(2)

SERVICE BATTERY OR VIEW RESULTS SCREEN  
Results can be viewed at any time during service.  
Battery parameter and test entries can be viewed at any time.

Current(1) or  
Previous(2)

SELECT RESULTS TO VIEW SCREEN  
View results of current battery or previous battery.

Hit the enter key to toggle between results "1 and 2" or "3 and 4", and hit the backspace key to return to the service battery or view results screen.

C1=74%    C2=85%  
V1=10.5V   V2=10.6V

RESULTS SCREEN  
Displays tested capacity and average voltage for each discharge.



# Specifications For Battery Analyzer Model 2406A

<b>CHEMISTRIES</b>	Nickel Cadmium, Nickel Metal Hydride, Lead Acid, Lithium Ion		
<b>CAPACITY RANGE</b>	50mAh to 60,000mAh.		
<b>VOLTAGE RANGE</b>	NiCd and NiMH	1-12 cells	1.2 – 14.4 V
	Lead acid	1-8 cells	2.0 – 16.0 V
	Lithium-Ion	1-4 cells	3.6 – 14.4 V
<b>INPUT VOLTAGE</b>	115 VAC , 2.0 Amps max. @ full load		
<b>FUSE</b>	5x20mm, 4 Amp, 250V.		
<b>OUTPUT POWER</b>	144 Watts		
<b>OUTPUT VOLTAGE</b>	0 – 24 VDC.		
<b>OUTPUT CURRENT</b>	0 – 6 Amps.		
<b>DISCHARGE POWER</b>	100 Watts.		
<b>DISCHARGE CURRENT</b>	0 – 6.25 Amps.		
<b>DIMENSIONS</b>	9.0 x 9.0 x 2.5 inches. L x W x H.		
<b>WEIGHT</b>	8.0 lbs.		
<b>CASE</b>	Aluminum with black anodized finish.		
<b>COOLING</b>	Forced air, 20 cfm.		
<b>CONNECTION</b>	Panel has 3 pin male Nuetrik connector. Accepts female part # NC3MP-B		
<b>ACCURACY</b>	± 0.5%		
<b>DISPLAY</b>	2x20 LCD with back light.		
<b>KEYPAD</b>	12 button, 3x4 matrix.		
<b>LED INDICATORS</b>	Power, Charge / Discharge, Pass / Fail, Done / Working.		
<b><u>CHARGE METHODS</u></b>			
<b>NiCd &amp; NiMH</b>	Constant current with multiple full charge detection techniques.		
<b>Lead Acid, SLA</b>	Constant voltage with current limit.		
<b>Lithium Ion</b>	Constant voltage with current limit.		