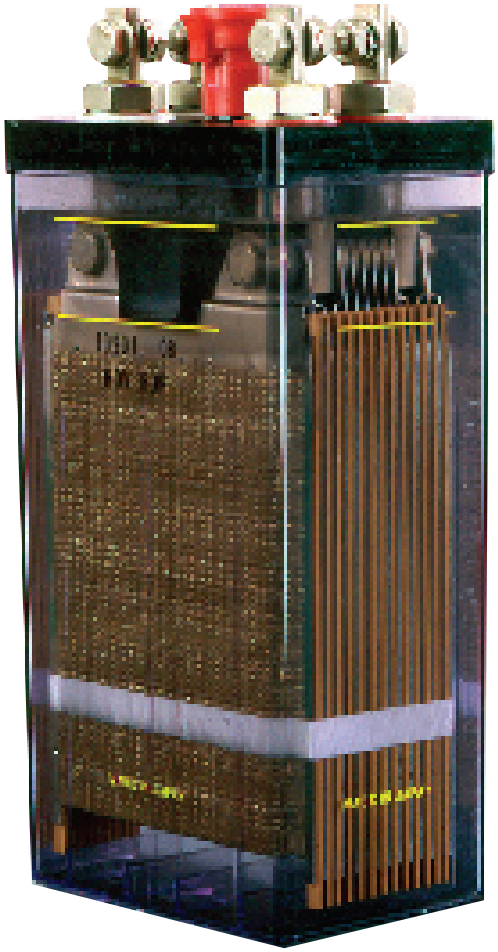
Nickel Cadmium Clear Case

Pocket Plate Battery



Technical Manual

Nickel Cadmium Clear Case Battery

Effective: February 2007

Alpha Technologies

Nickel Cadmium Clear Case

NI-CD-CLEAR-CASE

Effective Date: February 2007

Alpha Technologies, Inc.

member of The Group™

NOTE:

Photographs contained in this manual are for illustrative purposes only. These photographs may not match your installation.

NOTE:

Operator is cautioned to review the drawings and illustrations contained in this manual before proceeding. If there are questions regarding the safe operation of this product, please contact Alpha Technologies or your nearest Alpha representative.

NOTE:

Alpha shall not be held liable for any damage or injury involving its enclosures, power supplies, generators, batteries, or other hardware if used or operated in any manner or subject to any condition not consistent with its intended purpose, or is installed or operated in an unapproved manner, or improperly maintained.

Contacting Alpha Technologies: *www.alpha.com*

or

For general product information and customer service (7 AM to 5 PM, Pacific Time), call

1-800-863-3930,

For complete technical support, call

1-800-863-3364

7 AM to 5 PM, Pacific Time or 24/7 emergency support

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Tables and Figures

Safety Notes

Review the drawings and illustrations contained in this manual before proceeding. If there are any questions regarding the safe installation or operation of the system, contact Alpha Technologies or the nearest Alpha representative. Save this document for future reference.

To reduce the risk of injury or death, and to ensure the continued safe operation of this product, the following symbols have been placed throughout this manual. Where these symbols appear, use extra care and attention.

ATTENTION:

The use of ATTENTION is only for specific regulatory/code requirements that may affect the placement of equipment and installation procedures.

NOTE:

A NOTE gives readers additional information to help them complete a specific task or procedure.

CAUTION!

The use of CAUTION indicates safety information intended to PREVENT DAMAGE to material or equipment.

WARNING!

A WARNING presents safety information to PREVENT INJURY OR DEATH to the technician or user.

Battery Safety Notes

WARNING!

Nickel cadmium (NiCd) batteries contain dangerous voltages, currents and corrosive material. Battery installation, maintenance, service and replacement must be performed only by authorized personnel.

Chemical Hazards

The electrolyte in Nickel Cadmium batteries, consisting of a dilute caustic potash solution with a lithium hydroxide component, is harmful to the skin and eyes.

To avoid injury:

- The servicing and connection of batteries shall be performed by, or under the direct supervision of, personnel knowledgeable of batteries and the required safety precautions.
- Always wear eye protection, rubber gloves, and a protective vest when working near batteries. Remove all metallic objects from hands and neck.
- Batteries produce explosive gases. Keep all open flames and sparks away from batteries.
- Use tools with insulated handles, do not rest any tools on top of batteries.
- Wear protective clothing (insulated gloves, eye protection, etc.) when installing, maintaining, servicing, or replacing batteries.
- If any battery emission contacts the skin, wash immediately and thoroughly with water. Follow your company's approved chemical exposure procedures.
- Neutralize any spilled battery emission with plenty of water. If necessary, use sand to soak up the spill before diluting with water. Report a chemical spill using your company's spill reporting structure and seek medical attention if necessary.
- Always replace batteries with those of an identical type and rating. Never install old or untested batteries.
- Do not charge batteries in a sealed container. Each individual battery should have at least 0.5 inches of space between it and all surrounding surfaces to allow for convection cooling.
- All battery compartments must have adequate ventilation to prevent accumulation of potentially dangerous gas. Ventilation should prevent trapped hydrogen gas pockets from exceeding a 1% concentration as per regulation 70E of the National Fire Protection Agency (NFPA).
- Prior to handling the batteries, touch a grounded metal object to dissipate any static charge that may have developed on your body.
- Never use uninsulated tools or other conductive materials when installing, maintaining, servicing, or replacing batteries.
- Use special caution when connecting or adjusting battery cabling. An improperly connected or unconnected battery cable which makes contact with an unintended surface can result in arcing, fire, or possible explosion.
- Immediately replace any battery showing signs of cracking, leaking, or swelling. Batteries should be replaced only by authorized personnel with batteries of identical type and rating.

Equipment Cautions

- Do not operate NiCd and lead-acid batteries in the same room. NiCd emissions will neutralize the lead-acid solution, rendering the battery useless.
- Overcharging the battery can result in a loss of capacity and excess release of gas.

Recycling and Disposal Instructions

Spent or damaged batteries are considered environmentally unsafe. Always recycle used batteries or dispose of the batteries in accordance with all federal, state and local regulations.

1.0 Installation

Alpha's Clear Case Nickel Cadmium battery is designed and manufactured to provide battery power to support various industrial backup power applications. This high performance battery has four different discharge models to specifically meet the demands of the powering application.

- HDV Range (Very High)
- HDH Range (High)
- HDM Range (Medium)
- HDS Range (Long)

NiCd batteries do not emit any corrosive fumes and can be placed near sensitive electrical equipment. All batteries are built in accordance with IEC 60 623, EN60 623 and DIN 40 771 specifications.

Battery Operating Room Features

- Partitioned from other rooms and not exposed to the sun.
- Ideal room temperature of 77ºF (25ºC).
- Well ventilated (forced ventilation may be required).
- Adequately sloped floor for drainage of cleaning water. The battery frame must remain level.

Rack Installation

Steel racks, on which the battery will be mounted and arranged, come completely assembled and ready for installation.

- Place the steel rack in a level position, so each component cell remains level. To determine if the batteries are level, check the electrolyte against the level marks on the plastic cell containers. Place one or several thin vinyl chloride sheets or similar material under the racks if leveling is required.
- Carry each cell between two or three people, holding it as upright as possible, and mount it on the battery rack. The cells should be arranged and set up in accordance with the reference Wiring Diagram (included if both cells and racks are provided by Alpha). Take care to avoid possible polarity confusion.
- Using the supplied connector bars, connect the component unit batteries in series as shown in the reference Wiring Diagram. Tighten each connection with the supplied pole nut spanner.
- For safety, ensure the battery set is open circuited when connecting it to a battery charger.

CAUTION!

Packages are clearly marked with UP/DOWN labels. Do not turn the package upside down or to the side. Avoid excessive vibration or shock to the contents.

Unpacking and Inspection of Batteries

- Cautiously unpack the battery, protecting it from damage.
- Verify that the correct number of items were delivered and no damage occurred during shipping. If parts are missing or damaged, immediately contact the transporter or central office to procure missing or replacement parts.
- Carefully transport the cells to the battery room, keeping them level, and providing support for the bottom of the cell.

2.0 Electrolyte

WARNING!

Electrolyte can cause serious inflammation of the skin and destroys clothing; always wear protective equipment. If contact with the skin or eyes occurs, obtain medical treatment as soon as possible.

2.1 Preparation

The electrolyte used in nickel cadmium batteries is a solution of chemicaly pure potassium hydroxide (commonly known as caustic potash) mixed with powder lithium hydroxide and dissolved in distilled or ion-exchange purified water.

The electrolyte base is provided by Alpha and comes in a solid, dry tablet contained in a sealed vessel. Only use pure electrolyte to ensure the cell is not damaged. Prepare the electrolyte according to factory specifications. Contact Alpha for replacement electrolyte for your particular battery.

Electrolyte Notes

- A specific gravity of 1.21/68ºF (1.21/20°C) is ideal. While specific gravity values ranging from 1.16–1.23 at 68ºF (20°C) are acceptable, values above 1.23 may damage the cell, and values below 1.16 will result in a loss of capacity.
- The electrolyte solution has a different specific gravity depending on temperature. Specific gravity increases by 0.0005 per 1.8ºF (1°C) below 68ºF (20°C) and decreases by 0.0005 per 1.8ºF (1°C) above 68ºF (20°C).
- While mixing or storing electrolyte, use a vessel made of glass, porcelain steel, anti-alkaline plastic, nickel, or monel. Never use copper, aluminum, celluloid, or wood, as these will be corroded by the alkaline electrolyte.
- Electrolyte readily absorbs carbon dioxide from the air, forming potassium carbonate, which causes poor cell output. Keep the electrolyte in an air-tight container to avoid contamination.

2.2 Filling Cells

Cells are delivered empty of electrolyte solution and need to be filled before being put into service. Fill only cells which will be put into service immediately. Properly store cells that are not currently in use as instructed in section 5.0.

1. Remove the transport seal from the cell vents.
2. Using the electrolyte jug and funnel supplied, fill the cells slowly to a level slightly above the low level mark. Let stand. Refer to section 2.1 for electrolyte preperation and filling.
3. Check the cells after the first 30 minutes. If the level has dropped, add more electrolyte. The cells must stand for at least four hours to absorb the electrolyte.
4. Perform the first charge as soon as possible after the cells have had time to absorb the electrolyte. See section 3.2.

2.3 Topping Up

Since water electrolysis and evaporation are constantly taking place in the cell, causing the electrolyte level to lower over time, occasional topping up of the electrolyte is needed.

- Check the electrolyte level visually from the outside of the cell.
- Keep the electrolyte between the minimum and maximum level marks. Only use distilled or ion-exchange purified water to top off the electrolyte.

NOTE:

Charging accelerates the loss of water from the cell. Be sure to top up the cell before a charge or recharge.

2.4 Renewal

Over time, the density of electrolyte slowly decreases and it may accumulate various contaminates. Therefore, it is necessary to renew the electrolyte periodically. A renewal should generally be conducted once every five to six years, during which time, the specific gravity will likely have fallen to the lowest limit.

Renew the electrolyte in the cell when:

- The specific gravity has fallen below 1.16/68ºF (1.16/20ºC).
- The cells fail to work at the rated capacity.
- Contaminates or foreign materials, such as potassium carbonate, in the electrolyte have accumulated beyond 100 grams per liter.

Renewal Steps

1. Discharge the battery to 0.6–0.8Vpc at a 5 hour rate current (C_5).
2. After discharging, disconnect each cell from the string.
3. Open the filler cap of each cell, insert a siphon through the filler tube, and drain the old electrolyte completely. Dispose of the electrolyte in accordance with applicable local, state, and federal regulations. See section 2.1 Electrolyte Notes for more information.
4. Do not allow the cells to remain empty for too long or rinse the interior with water. Fill up each cell with new electrolyte, using a funnel and a jug (both supplied). Only use type HONDA B-20 or A electrolyte. Ensure the specific gravity of the solution is 1.21 ± 0.01.
5. Close the vent valves and clean the outside of each cell.
6. Make sure all cells are put in place and properly connected as they were before.
7. Conduct an equalizing charge according to section 3.3.

3.0 Charging

NOTE:

The charge state of the battery cannot be judged by measuring the specific gravity of its electrolyte.

NOTE:

Refer to your particular charger's manual for specific instructions regarding charger setup and operation.

About Charging Temperatures

An electrolyte temperature of 68°F (20°C)–77°F (25°C) is ideal for charging. The temperature of the electrolyte gradually rises as charging continues. Cells are capable of withstanding an electrolyte temperature of up to113°F (45°C) without damage or loss of capacity.

CAUTION!

Cells can withstand temperatures up to 122°F (50°C) for short periods of time, but high temperatures should be avoided. If the temperature exceeds 113°F (45°C), suspend charging temporarily, and resume after the temperature has dropped sufficiently.

3.1 Pre-Charge Preparation

1. Verify that the AC power source and the battery charger are in normal condition.
2. Measure the voltage of the entire battery as well as the voltage of each cell.
3. Check the specific gravity and temperature of the electrolyte for irregularities.
4. Connect the negative pole of the battery to the negative terminal of the charger and the positive pole to the the positive terminal.
5. Verify that the vent valve on each cell is closed.

3.2 General Charge

The charging current should equal 10% of the battery capacity. For example, the HDS 20P has a capacity of 20AH and requires a charging current of 2 Amps for 20 hours.

1. Charge at 0.1 x C_{10}(A) for 20 hours until the charging voltage has risen to a constant 1.65–1.80Vpc for 2.5–3 hours.
2. Check all the cells for the proper electrolyte density and level.
3. Discharge the battery at a 5 hour rate to 1.0Vpc level. (See section 7.1)
4. Charge at 0.1 x C_{10}(A) for 20 hours until the charging voltage has risen to a constant 1.65–1.80Vpc for 2.5–3 hours.
5. Check all the cells for proper electrolyte density and level.

3.2 General Charge, continued

Cell voltage gradually rises as the charging continues. To maintain the charging current at the specified rate, raise the rectifier's output voltage using the manual output voltage regulator.

Taking measurements before and after charging and during discharge helps to track changes and identify problems. Use forms like those in section 7.0 to record the results. Wait two hours after charging before taking final measurements, to allow the electrolyte to cool sufficiently.

NOTE:

After the first charge, it is possible the battery may be discharged significantly due to various tests involving load. If this occurs, charge again using the 10 hour rate current for 14 hours before putting the battery into service.

3.3 Equalizing Charge

An equalizing charge restores battery capacity and efficiency. Conduct an equalizing charge after initially filling the cell with electrolyte, renewing the electrolyte, when the cell voltages become unbalanced, or once every six months if the battery has been in floating charge mode, but not discharged.

Equalizing charge procedure after filling the cell with new electrolyte

1. Set the charging equipment to the "EQUALIZING" position.
2. After 24 hours, set the battery back to the float charge by setting the charging equipment to the "FLOAT" position.

Equalizing charge procedure after discharge or voltage imbalance

1. Set the charging equipment to the "EQUALIZING" position.
2. After 8-10 hours, set the battery back to the float charge by setting the charging equipment to the "FLOAT" position.

The proper voltage level (see Table 3-1) should be reached within a relatively short period. If this level, or higher, is not reached at the end of the equalizing charge, re-adjust the equalizing charge voltage or increase the charge time.

Cell Type	Equalizing Charge Voltage (Vpc)
HDV	1.52–1.57
HDH	1.55–1.65
HDM	1.55–1.65
HDS	1.55–1.70

Table 3-1, Equalizing Charge Voltage

3.4 Floating Charge

When connected to a floating charge, the battery is kept in a fully charged state. Floating charge voltage is normally 1.40–1.50Vpc (see Table 3-2) and the ampere is about 1/40 of a 5 hour rate current (1/200 C). Adjust these values accordingly; too much gassing or water consumption means the charging voltage is too high, whereas a gradual drop of capacity indicates the charging voltage is too low.

Total floating charge voltage is obtained by multiplying the standard per-cell voltage by the number of cells within the battery. If something unusual is detected, check the load side for the cause.

Cell Type	Floating Charge Voltage (Vpc)
HDV	1.40–1.42
HDH	1.40–1.42
HDM	1.40–1.45
HDS	1.40–1.45

Table 3-2, Floating Charge Voltage

4.0 Maintenance

A battery gives optimum performance and longer life when given proper maintenance. It is important to inspect batteries periodically and record the results found at each inspection. Should something unusual be found, discover the cause as soon as possible.

In order to determine the type and frequency of maintenance needed during normal service, conduct maintenance checks on the battery monthly during the first few months of service.

Practices for proper maintenance:

- Clean the outside of the battery, especially the cell top and pole assemblies, at least once a month. Apply a sufficient quantity of anti-rust oil (supplied by Alpha Technologies) or petroleum jelly to the nickel plated parts.
- Tighten the poles or other connections occasionally.
- Avoid using solder and similar materials to repair the battery.
- Do not use sand paper or emery cloth on nickel plated parts as they will damage the nickel plating, resulting in increased resistance and rusting.

4.1 Inspection Check Points

What to Check	How Often	Action Required
Floating charge voltage	Once a month	Refer to section 3.4.
Terminal voltage of cell	Every 3 months	Measure it with a voltmeter.
Electrolyte level	Every 2 months	Refer to section 2.3.
Clamped part of connector	Every 3 months	Using a pole spanner, tighten bolts and nuts if loose.
Appearance of container and cell cover	Every 3 months	Check to see if any cell container or cell cover is broken.
Conduct equalizing charge	Every 6 months	Refer to section 3.3.

Table 4-1, Inspection Check Points

5.0 Storage

A charged battery can be stored for up to six months but will suffer a gradual loss in capacity. If a battery is to be put back into service in less than six months, fully recharge it every three months with the 10 hour rate current for 14 hours.

If a battery will be stored for a period longer than six months, completely discharge it, completely remove the electrolyte, thouroughly dry the inside, and close the vent plug of each cell.

Store the battery in a room which is clean, cool, dark and dry. When putting the battery back into service, fill every cell with electrolyte as instructed in section 2.2 and then charge it fully by following the charging procedure explained in section 3.3.

6.0 Replacement Parts

If any accessory items or component parts are missing or damaged at the time of delivery or are found to be defective at the time of maintenance, replacements can be ordered by contacting customer service with the following information. Part numbers and nomenclatures can be found in the specifications.

- Type of the battery and number of the cells
- Part Number and Nomenclature
- Quantity
- Reasons replacements ordered (e.g., lost or damaged during the transit or deteriorated while in use)
- Destination of the shipment, which should include the name and full address of the company and, if applicable, the name of the person responsible for receiving the shipment

7.0 Forms

Charging Recording Form

Record before charging and two hours after

Model of Battery		Date	
Battery Bank No.		Room Temperature	
Charging Current		Total Battery Voltage	
Remarks			

Cell #	Voltage	S.G. of Electrolyte	Electrolyte Temperature

NOTE:

Wait two hours before taking final readings, to allow the electrolyte to cool.

Fig. 7-1, Charge Recording Form

7.0 Forms. continued

Discharge Recording Form

Model of Battery		Date	
Battery No.		Room Temperature	
Charging Current		Total Battery Voltage	
Remarks			

Cell #	Inital Voltage	Cell Voltage at Time Period End							
		15min	30min	1hr	2hr	3hr	4hr	4:30hr	5 hr

Fig. 7-2, Discharge Recording Form

8.0 Specifications

8.1 General Specifications

Specifications are subject to change without notice.

HDM-P (E)

Cell Type			Dimension(mm)				Wgt(kg)incl electrolyte	Electrolyte(ℓ)
Vented type	Sealed type		H		W	L		
			Vented	Sealed				
HDM 20 P	HDM 20 PE		272	333	143	52	2.6	0.9
HDM 30 P	HDM 30 PE		272	333	143	52	2.9	0.8
HDM 40 P	HDM 40 PE		272	333	143	52	3.1	0.7
HDM 50 P	HDM 50 PE		266	333	143	76	4.2	1.2
HDM 60 P	HDM 60 PE		266	333	143	76	4.5	1.1
HDM 80 P	HDM 80 PE		270	333	145	100	5.8	1.6
HDM 100 P	HDM 100 PE		370	455	170	120	9.6	3.4
HDM 120 P	HDM 120 PE		370	455	170	120	10.0	3.3
HDM 150 P	HDM 150 PE		370	455	170	120	11.0	3.0
HDM 200 P	HDM 200 PE		370	455	195	170	17.5	5.7
HDM 250 P	HDM 250 PE		370	455	195	170	18.0	5.2
HDM 300 P	HDM 300 PE		370	455	195	170	19.5	4.7
HDM 350 P	HDM 350 PE		370	455	285	170	26.5	8.5
HDM 400 P	HDM 400 PE		370	455	285	170	28.0	8.0
HDM 450 P	HDM 450 PE		370	455	285	170	29.0	7.5
HDM 500 P	HDM 500 PE		370	455	390	170	37.0	11.0
HDM 600 P	–		372	–	390	170	39.0	10.0
HDM 700 P	–		372	–	515	170	50.0	15.0
HDM 800 P	–		372	–	515	170	53.0	14.0
HDM 900 P	–		372	–	515	170	56.0	13.0
HDM 1000 P	–		372	–	515	170	58.0	12.0

HDS-P (E)

Cell Type			Dimension(mm)				Wgt(kg)incl electrolyte	Electrolyte(ℓ)
Vented type	Sealed type		H		W	L		
			Vented	Sealed				
HDS 20 P			268	–	76.5	48.5	1.5	0.3
HDS 30 P	HDS 30 PE		272	333	143	52	2.8	0.9
HDS 40 P	HDS 40 PE		272	333	143	52	2.9	0.8
HDS 50 P	HDS 50 PE		272	333	143	52	3.0	0.7
HDS 60 P	HDS 60 PE		266	333	143	76	4.1	1.2
HDS 80 P	HDS 80 PE		266	333	143	76	4.5	1.1
HDS 100 P	HDS 100 PE		270	373	145	100	6.0	1.5
HDS 120 P	HDS 120 PE		370	455	170	120	9.0	3.4
HDS 150 P	HDS 150 PE		370	455	170	120	9.5	3.2
HDS 200 P	HDS 200 PE		370	455	170	120	10.0	2.8
HDS 250 P	HDS 250 PE		370	455	195	170	16.0	5.4
HDS 300 P	HDS 300 PE		370	455	195	170	18.0	5.0
HDS 350 P	HDS 350 PE		370	455	195	170	19.0	4.6
HDS 400 P	HDS 400 PE		370	455	285	170	24.5	8.2
HDS 450 P	HDS 450 PE		370	455	285	170	25.5	7.8
HDS 500 P	HDS 500 PE		370	455	285	170	27.0	7.0
HDS 600 P	–		370	–	390	170	36.0	10.3
HDS 700 P	–		370	–	390	170	37.5	9.5
HDS 800 P	–		370	–	390	170	39.0	8.7
HDS 900 P	–		372	–	515	170	48.0	13.0
HDS 1000 P	–		372	–	515	170	50.0	12.0

HDV-P (E)

Cell Type			Dimension(mm)				Wgt(kg)incl electrolyte	Electrolyte(ℓ)
Vented type	Sealed type		H		W	L		
			Vented	Sealed				
HDV 20 P	HDV 20 PE		272	333	143	52	3.1	0.7
HDV 30 P	HDV 30 PE		282	333	143	76	4.7	1.3
HDV 40 P	HDV 40 PE		282	333	143	76	5.2	1.0
HDV 50 P	HDV 50 PE		282	333	145	100	6.9	1.4
HDV 60 P	HDV 60 PE		282	333	145	100	7.2	1.2
HDV 80 P	HDV 80 PE		370	455	120	170	11.0	2.8
HDV 100 P	HDV 100 PE		370	455	120	170	12.0	2.4
HDV 120 P	HDV 120 PE		370	455	195	170	17.0	5.3
HDV 150 P	HDV 150 PE		370	455	195	170	19.5	4.6
HDV 200 P	HDV 200 PE		370	455	285	170	27.0	7.6
HDV 250 P	HDV 250 PE		370	455	285	170	31.0	6.4
HDV 300 P	HDV 300 PE		370	455	390	170	39.0	9.4
HDV 350 P	HDV 350 PE		370	455	390	170	42.0	8.6
HDV 400 P	HDV 400 PE		372	457	515	170	51.0	13.0
HDV 450 P	HDV 450 PE		372	457	515	170	55.0	12.0

HDH-P (E)

Cell Type			Dimension(mm)				Wgt(kg)incl electrolyte	Electrolyte(ℓ)
Vented type	Sealed type		H		W	L		
			Vented	Sealed				
HDH 20 P	HDH 20 PE		272	333	143	52	2.9	0.9
HDH 30 P	HDH 30 PE		272	333	143	52	3.2	0.7
HDH 40 P	HDH 40 PE		266	333	143	76	4.5	1.2
HDH 50 P	HDH 50 PE		266	333	143	76	4.7	1.1
HDH 60 P	HDH 60 PE		278	333	145	100	6.1	1.6
HDH 80 P	HDH 80 PE		278	333	145	100	6.6	1.3
HDH 100 P	HDH 100 PE		370	455	170	120	11.0	3.2
HDH 120 P	HDH 120 PE		370	455	170	120	12.0	2.9
HDH 150 P	HDH 150 PE		370	455	170	120	13.0	2.6
HDH 200 P	HDH 200 PE		370	455	195	170	19.0	5.2
HDH 250 P	HDH 250 PE		370	455	195	170	21.5	4.4
HDH 300 P	HDH 300 PE		370	455	285	170	29.0	7.8
HDH 350 P	HDH 350 PE		370	455	285	170	31.0	7.2
HDH 400 P	HDH 400 PE		370	455	285	170	32.5	6.7
HDH 450 P	HDH 450 PE		370	455	390	170	43.5	10.0
HDH 500 P	HDH 500 PE		370	455	390	170	45.0	9.5
HDH 600 P	–		372	–	515	170	56.0	13.5
HDH 700 P	–		372	–	515	170	60.0	12.0

Table 8-1, Dimensions and Weight

8.2 Discharge Voltage

Specifications are subject to change without notice.

END VOLTAGE 1.14V/CELL

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

CELL TYPE	C_5 Ah-1.10 V	Hours 10	8	5	3	2	1.5	1	Minutes 30	20	15	10	5	1	Seconds 30	15	5	1
HDV 10P	10							9.3	16.1	20.8	25.0	31.3	38.5	52.6	55.6	58.1	58.8	76.9
HDV 20P	20							18.5	32.3	41.7	50	62.5	76.9	105	111	116	118	154
HDV 30P	30							27.8	48.4	62.5	75	93.8	115	158	167	174	176	231
HDV 40P	40							37	64.5	83.3	100	125	154	211	222	233	235	308
HDV 50P	50							46.3	80.7	104	125	156	192	263	278	291	294	385
HDV 60P	60							55.6	96.8	125	150	188	231	316	333	349	353	462
HDV 80P	80							74.1	129	167	200	250	308	421	444	465	471	615
HDV 100P	100							92.6	161	208	250	313	385	526	556	581	588	769
HDV 120P	120							111	194	250	300	375	462	632	667	698	706	723
HDV 150P	150							139	242	313	375	469	577	789	833	872	882	1150
HDV 200P	200							185	323	417	500	625	769	1050	1110	1160	1170	1530
HDV 250P	250							231	403	521	625	781	962	1310	1380	1450	1470	1920
HDV 300P	300							278	484	625	750	938	1150	1570	1660	1740	1760	2300
HDV 350P	350							324	565	729	875	1090	1340	1840	1940	2030	2050	2690
HDV 400P	400							370	645	833	1000	1250	1530	2100	2220	2320	2350	3070
HDV 450P	450							417	726	938	1120	1400	1730	2360	2500	2610	2640	3460
HDH 10P	10	1.01	1.26	2	2.94	4.07	5.08	6.94	11.8	14.7	16.7	19.6	23.3	31.3	245	37	41.7	50
HDH 20P	20	2.02	2.51	4	5.88	8.13	10.2	13.9	23.5	29.4	33.3	39.2	46.5	62.5	69	74.1	83.3	100
HDH 30P	30	3.03	3.77	6	8.82	12.2	15.2	20.8	35.3	44.1	50	58.8	69.8	93.8	103	111	125	150
HDH 40P	40	4.04	5.03	8	11.8	16.3	20.3	27.8	47.1	58.8	66.7	78.4	93.8	125	138	148	167	200
HDH 50P	50	5.05	6.28	10	14.7	20.3	25.4	34.7	58.8	73.5	83.3	98	116	156	172	185	208	250
HDH 60P	60	6.06	7.54	12	17.7	24.4	30.5	41.7	70.6	88.2	100	118	140	188	207	222	250	300
HDH 80P	80	8.08	10.1	16	23.5	32.5	40.6	55.6	94.1	118	133	157	186	250	276	296	333	400
HDH 100P	100	10.1	12.5	20	29.4	40.7	50.8	69.4	118	147	167	196	233	313	345	370	417	500
HDH 120P	120	12.1	15.1	24	35.3	48.8	60.9	83.3	141	176	200	235	279	375	414	444	500	600
HDH 150P	150	15.2	18.8	30	44.1	61	76.1	104	176	221	250	294	349	469	517	556	625	750
HDH 200P	200	20.2	25.1	40	58.8	81.3	102	139	235	294	333	392	465	625	690	741	833	1000
HDH 250P	250	25.3	31.4	50	73.5	102	127	174	294	368	417	481	543	658	714	781	850	1050
HDH 300P	300	30.3	37.7	60	88.2	122	152	208	353	441	500	577	652	789	857	938	1000	1150
HDH 350P	350	35.4	44	70	103	142	178	243	412	515	583	673	761	921	1000	1090	1167	1340
HDH 400P	400	40.4	50.3	80	118	163	203	278	471	588	667	769	870	1050	1140	1250	1330	1530
HDH 450P	450	45.5	56.5	90	132	183	228	313	529	662	750	865	978	1180	1280	1400	1500	1730
HDH 500P	500	50.5	62.8	100	147	203	254	347	588	735	833	962	1080	1320	1420	1560	1660	1920
HDH 600P	600	60.6	75.4	120	176	244	305	417	706	882	1000	1150	1300	1570	1710	1870	2000	2300
HDH 700P	700	70.7	87.9	140	206	285	355	486	824	1020	1160	1340	1520	1840	2000	2180	2330	2690
HDM 10P	10	0.97	1.20	1.89	2.82	3.76	4.55	5.92	8.47	9.90	10.80	11.70	12.50	14.70	15.60	16.30	17.80	27.70
HDM 20P	20	1.94	2.41	3.77	5.63	7.52	9.09	11.80	17.00	19.80	21.50	23.50	25.00	29.40	31.30	32.80	35.70	55.60
HDM 30P	30	2.91	3.61	5.66	8.45	11.30	13.60	17.80	25.40	29.70	32.30	35.30	37.50	44.10	46.90	49.20	53.60	83.30
HDM 40P	40	3.88	4.82	7.55	11.3	15	18.2	23.7	33.9	39.6	43	47	50	58.8	62.5	65.6	71.4	111
HDM 50P	50	4.85	6.02	9.43	14.1	18.8	22.7	29.6	42.4	49.5	53.8	58.8	62.5	73.5	78.1	820	89.3	139
HDM 60P	60	5.83	7.23	11.3	16.9	22.6	27.3	35.5	50.9	59.4	64.5	70.6	75	88.2	93.8	98.4	107	167
HDM 80P	80	7.77	9.64	15.1	22.5	30.1	36.4	47	67.8	79.2	86	94.1	100	118	125	131	143	222
HDM 100P	100	9.71	121	18.9	28.2	37.6	45.5	59.2	84.8	99	108	118	125	147	156	164	179	278
HDM 120P	120	11.7	14.5	22.6	33.8	45.1	54.6	71	102	119	129	141	150	176	188	197	214	333
HDM 150P	150	14.6	18.1	28.3	42.3	56.4	68.2	88.8	127	149	161	176	188	221	234	246	268	417
HDM 200P	200	19.4	24.1	37.7	56.3	75.2	90.9	118	169	198	215	235	250	294	313	328	357	556
HDM 250P	250	24.3	30.1	47.2	70.4	94	114	148	212	248	269	294	313	368	391	410	446	694
HDM 300P	300	29.1	361	56.6	84.5	113	136	178	254	297	323	353	375	441	469	492	536	833
HDM 350P	350	34	42.2	66	98.6	132	159	207	297	347	376	412	438	515	547	572	625	972
HDM 400P	400	38.8	48.2	75.5	113	150	182	237	339	396	430	471	500	588	625	656	714	1110
HDM 450P	450	43.7	54.2	85.9	127	169	205	266	381	446	484	529	563	662	703	738	804	1250
HDM 500P	500	48.5	60.2	94.3	141	188	227	296	424	495	538	588	625	735	781	820	893	1380
HDM 600P	600	58.3	72.3	113	169	226	273	355	508	594	645	706	750	882	938	984	1070	1660
HDM 700P	700	68	84.3	132	197	263	318	414	593	693	753	824	875	1020	1090	1140	1250	1940
HDM 800P	800	777	964	151	225	301	364	473	678	792	860	941	1000	1170	1250	1310	1420	2220
HDM 900P	900	87.4	108	170	254	338	409	533	763	891	968	1050	1120	1320	1400	1470	1600	2500
HDM 1000P	1000	97.1	120	189	282	376	455	592	847	990	1080	1170	1250	1470	1560	1630	1780	2770
HDS 10P	10	0.94	1.15	175	2.38	299	3.5	4.33	5.75	6.37	6.67	7.14	7.75	9.35	9.9	104		
HDS 20P	20	1.87	2.3	3.51	4.76	5.99	6.99	8.66	11.5	12.7	13.6	14.7	16.8	21.3	23.5	25.3		
HDS 30P	30	280	3.45	5.26	7.14	8.98	10.5	13	17.2	19.1	20.4	22.1	25.2	31.9	35.3	38		
HDS 40P	40	374	4.6	7.02	9.52	12	14	17.3	23	25.5	27.2	29.4	33.6	42.6	47.1	50.6		
HDS 50P	50	4.67	575	8.77	11.9	15	17.5	21.7	28.7	31.9	34	36.8	42	53.2	58.8	63.3		
HDS 60P	60	5.61	6.9	10.5	14.3	18	21	26	34.5	38.2	40.8	44.1	50.4	63.8	70.6	76		
HDS 80P	80	7.48	9.2	14	19.1	24	28	34.6	46	51	54.4	58.8	67.2	85.1	94.1	101		
HDS 100P	100	9.35	11.5	17.5	23.8	29.9	35	43.3	57.5	63.7	68	73.5	84	106	118	127		
HDS 120P	120	11.2	13.8	21.1	28.6	35.9	42	52	69	76.4	81.6	882	101	128	141	152		
HDS 150P	150	14	17.2	26.3	35.7	44.9	52.5	64.9	86.2	95.5	102	110	126	160	176	190		
HDS 200P	200	18.7	23	35.1	47.6	59.9	69.9	86.6	115	127	136	147	168	213	235	253		
HDS 250P	250	23.4	28.7	43.9	59.5	74.9	87.4	108	144	159	167	179	194	234	248	260		
HDS 300P	300	280	34.5	52.6	71.4	89.8	105	130	172	191	200	214	233	280	297	313		
HDS 350P	350	32.7	40.2	61.4	83.3	105	122	152	201	223	233	250	271	327	347	365		
HDS 400P	400	37.4	46	70.2	95.2	120	140	173	230	255	267	286	310	374	396	417		
HDS 450P	450	42.1	51.7	79	107	135	157	195	259	287	300	321	349	421	446	469		
HDS 500P	500	46.7	57.5	87.7	119	150	175	216	287	318	333	357	388	467	495	521		
HDS 600P	600	561	69	105	143	180	210	260	345	382	400	429	465	561	594	625		
HDS 700P	700	65.4	80.5	123	167	210	245	303	402	446	467	500	543	654	707	729		
HDS 800P	800	74.8	92	140	190	240	280	346	460	510	533	571	620	748	792	833		
HDS 900P	900	84.1	103	158	214	270	315	290	517	573	600	643	698	841	909	938		
HDS 1000P	1000	93.5	115	175	238	299	350	433	575	637	667	714	775	935	990	1049		

Table 8-2, Discharge End Voltage 1.14Vpc

8.2 Discharge Voltage, continued

Specifications are subject to change without notice.

END VOLTAGE 1.10V/CELL

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

CELL TYPE	C_5 Ah-1.10 V	Hours 10	8	5	3	2	1.5	1	Minutes 30	20	15	10	5	1	Seconds 30	15	5	1
HDV 10P	10							9.6	17.5	23.8	29.4	37.0	455.0	58.8	66.7	69.0	71.4	89.3
HDV 20P	20							19.2	35.1	47.6	58.8	74.1	90.9	118	133	138	143	179
HDV 30P	30							28.9	52.6	71.4	88.2	111	136	176	200	207	214	268
HDV 40P	40							38.5	70.2	95.2	118	148	182	235	267	276	286	357
HDV 50P	50							48.1	87.7	119	147	185	227	294	333	345	357	446
HDV 60P	60							57.7	105	143	176	222	273	353	400	414	429	536
HDV 80P	80							76.9	140	190	235	296	364	471	533	552	571	714
HDV 100P	100							96.2	175	238	294	370	455	588	667	690	714	893
HDV 120P	120							115	211	286	353	444	545	706	800	828	857	1070
HDV 150P	150							144	263	357	441	556	682	882	1000	1030	1070	1330
HDV 200P	200							192	351	476	588	741	909	1170	1330	1380	1420	1780
HDV 250P	250							240	439	595	735	926	1130	1470	1660	1720	1780	2230
HDV 300P	300							288	526	714	882	1110	1360	1760	2000	2070	2140	2670
HDV 350P	350							337	614	833	1020	1290	1590	2050	2330	2410	2500	3120
HDV 400P	400							385	702	952	1170	1480	1810	2350	2660	2760	2850	3570
HDV 450P	450							433	789	1070	1320	1660	2040	2640	3000	3100	3210	4010
HDH 10P	10	1.02	1.26	2.01	3.17	4.37	5.56	7.75	13.7	17.9	20.8	25	29.4	38.5	41.7	45.5	50.5	58.8
HDH 20P	20	2.03	2.53	4.02	6.35	8.73	11.1	15.5	27.4	35.7	41.7	50	58.8	76.9	83.3	90.9	100	118
HDH 30P	30	3.05	3.79	6.03	9.52	13.1	16.7	23.3	41.1	53.6	62.5	75	88.2	115	125	136	150	176
HDH 40P	40	4.06	5.05	8.04	12.7	17.5	22.2	31	54.8	71.4	83.3	100	118	154	167	182	200	235
HDH 50P	50	5.08	6.31	10.1	15.9	21.8	27.8	38.8	68.5	89.3	104	125	147	192	206	227	250	294
HDH 60P	60	6.09	7.58	12.1	19	26.2	33.3	46.5	82.2	107	125	150	176	231	250	273	300	353
HDH 80P	80	8.12	10.1	16.1	25.4	349	44.4	62	110	143	167	200	235	308	333	364	400	471
HDH 100P	100	10.2	12.6	20.1	31.7	43.7	55.6	77.5	137	179	208	250	294	385	417	455	500	588
HDH 120P	120	12.2	15.2	24.1	38.1	52.4	66.7	93	164	214	250	300	353	462	500	545	600	706
HDH 150P	150	15.2	18.9	30.2	47.6	65.5	83.3	116	205	268	313	375	441	577	625	682	750	882
HDH 200P	200	20.3	25.2	40.2	63.5	87.3	111	155	274	357	417	500	588	769	833	909	1000	1170
HDH 250P	250	25.4	31.6	50.3	794	109	139	194	342	446	521	581	676	833	893	962	1040	1190
HDH 300P	300	30.5	37.9	60.3	95.2	131	167	233	411	536	625	698	811	1000	1070	1150	1250	1420
HDH 350P	350	35.5	44.2	70.4	111	153	194	271	479	625	729	814	946	1160	1250	1340	1450	1660
HDH 400P	400	40.6	50.5	80.4	127	175	222	310	548	714	833	930	1080	1330	1420	1530	1660	1900
HDH 450P	450	45.7	56.8	90.5	143	197	250	349	616	804	938	1040	1210	1500	1600	1730	1870	2140
HDH 500P	500	50.8	63.1	101	159	218	278	388	685	893	1040	1160	1350	1660	1780	1920	2080	2380
HDH 600P	600	60.9	75.8	121	190	262	333	465	822	1070	1250	1390	1620	2000	2140	2300	2500	2850
HDH 700P	700	71.1	88.4	141	222	306	389	543	959	1250	1450	1620	1890	2330	2500	2690	2910	3330
HDM 10P	10	1.01	1.26	2.00	3.13	4.26	5.29	6.9	10.0	11.6	12.8	14.2	15.6	18.5	19.6	21.2	22.7	31.2
HDM 20P	20	2.02	2.51	4.00	6.25	8.51	10.6	13.8	20.0	23.3	25.6	28.6	31.3	37.0	39.2	42.6	45.5	62.5
HDM 30P	30	3.03	3.77	6.00	9.38	12.80	15.9	20.7	30.0	34.9	38.5	42.9	46.9	55.6	58.8	63.8	68.2	93.8
HDM 40P	40	4.04	5.03	8	12.5	17	21.2	27.6	40.0	46.5	51.3	57.1	62.5	74.1	78.4	85.1	90.9	125
HDM 50P	50	5.05	6.28	10	15.6	21.3	26.5	34.5	50.0	58.1	64.1	71.4	78.1	92.6	98	106	114	156
HDM 60P	60	6.06	7.54	12	18.8	25.5	31.8	41.4	60.0	70	76.9	85.7	93.8	111	118	128	136	188
HDM 80P	80	8.08	10.1	16	25	34	42.3	55.2	80.0	93	103	114	125	148	157	170	182	250
HDM 100P	100	10.1	12.6	20	31.3	42.6	52.9	69	100	116	128	143	156	185	196	213	227	313
HDM 120P	120	12.1	15.1	24	37.5	51.1	63.5	82.8	120	140	154	171	188	222	235	255	273	375
HDM 150P	150	15.2	18.8	30	46.9	63.8	79.4	103	150	174	192	214	234	278	294	319	341	469
HDM 200P	200	20.2	25.1	40	62.5	85.1	106	138	200	233	256	286	313	370	392	426	455	625
HDM 250P	250	25.3	31.4	50	78.1	106	132	172	250	291	321	357	391	463	490	532	568	781
HDM 300P	300	30.3	3.7	60	93.8	128	159	207	300	349	385	429	469	556	588	638	682	938
HDM 350P	350	35.4	44	70	109	149	185	241	350	407	449	500	547	648	686	745	795	1090
HDM 400P	400	40.4	50.3	80	125	170	212	276	400	465	513	571	625	741	784	851	909	1250
HDM 450P	450	45.5	56.5	90	141	191	238	310	450	523	577	643	703	833	882	957	1020	1400
HDM 500P	500	50.5	62.8	100	156	213	265	345	500	581	641	714	781	926	980	1060	1130	1560
HDM 600P	600	60.6	75.4	120	188	255	317	414	600	698	769	857	938	1110	1170	1270	1360	1870
HDM 700P	700	70.7	87.9	140	219	298	370	483	700	814	897	1000	1090	1290	1370	1480	1590	2180
HDM 800P	800	80.8	101	160	250	340	423	552	800	934	1020	1140	1250	1480	1560	1700	1810	2500
HDM 900P	900	90.9	113	180	281	383	476	621	900	1040	1150	1280	1400	1660	1760	1910	2040	2810
HDM 1000P	1000	101	126	200	313	426	529	690	1000	1160	1280	1420	1560	1850	1960	2120	2270	3120
HDS 10P	10	0.97	1.2	1.89	2.7	3.5	4.15	5.15	6.67	7.58	8.06	8.55	9.35	11.1	11.7	12.1		
HDS 20P	20	1.94	2.41	3.77	5.41	6.99	8.3	10.3	13.3	15.2	16.1	17.4	20.2	26	28.2	30.3		
HDS 30P	30	2.91	3.61	5.66	8.11	10.5	12.5	15.5	20	22.7	24.2	26.1	30.3	39	42.3	45.5		
HDS 40P	40	3.88	4.82	7.55	10.8	14	16.6	20.6	26.7	30.3	32.3	34.8	40.4	52	56.3	60.6		
HDS 50P	50	4.85	6.02	9.43	13.5	17.5	20.8	25.8	33.3	37.9	40.3	43.5	50.5	64.9	70.4	75.8		
HDS 60P	60	5.83	7.23	11.3	16.2	21	24.9	30.9	40	45.5	48.4	52.2	60.6	77.9	84.5	90.9		
HDS 80P	80	777	9.64	15.1	21.6	28	33.2	41.2	53.3	60.6	64.5	69.6	80.8	104	113	121		
HDS 100P	100	9.71	12.1	18.9	27	35	41.5	51.6	66.7	75.8	80.7	87	101	130	141	152		
HDS 120P	120	11.7	14.5	22.6	32.4	42	49.8	61.9	80	90.9	96.8	104	121	156	169	182		
HDS 150P	150	14.6	18.1	28.3	40.5	52.5	62.2	77.3	100	114	121	130	152	195	211	227		
HDS 200P	200	19.4	24.1	37.7	54.1	69.9	83	103	133	152	161	174	202	260	282	303		
HDS 250P	250	24.3	30.1	47.2	67.6	87.4	104	129	167	189	202	214	234	278	294	305		
HDS 300P	300	29.1	36.1	56.6	81.1	105	124	155	200	227	242	256	280	333	353	366		
HDS 350P	350	34	42.2	66	94.6	122	145	180	233	265	282	299	327	389	412	427		
HDS 400P	400	38.8	48.2	75.5	108	140	166	206	267	303	323	342	374	444	471	488		
HDS 450P	450	43.7	54.2	84.9	122	157	187	232	300	341	363	385	421	500	529	549		
HDS 500P	500	78.5	60.2	94.3	135	175	207	258	333	379	403	427	467	556	588	610		
HDS 600P	600	58.3	72.3	113	162	210	249	309	400	455	484	513	561	667	706	732		
HDS 700P	700	68	84.3	132	189	245	290	361	467	530	565	598	654	778	824	854		
HDS 800P	800	77.7	96.4	151	216	280	332	412	533	606	645	684	748	889	941	976		
HDS 900P	900	87.4	108	170	243	315	373	464	600	682	726	769	841	1000	1050	1090		
HDS 1000P	1000	97.1	120	189	270	350	415	515	667	758	806	855	935	1110	1170	1210		

Table 8-3, Discharge End Voltage 1.10Vpc

8.2 Discharge Voltage, continued

Specifications are subject to change without notice.

END VOLTAGE 1.06V/CELL

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

CELL TYPE	C_5 Ah-1.10 V	Hours 10	8	5	3	2	1.5	1	Minutes 30	20	15	10	5	1	Seconds 30	15	5	1
HDV 10P	10							10.2	18.9	26.3	33.3	43.5	55.6	76.9	83.3	87.7	90.9	107.0
HDV 20P	20							20.4	37.7	52.6	66.7	87	111	154	167	175	182	215
HDV 30P	30							30.6	56.6	79	100	130	167	231	250	263	273	323
HDV 40P	40							40.8	75.5	105	133	174	222	308	333	351	364	430
HDV 50P	50							51.8	94.3	132	167	217	278	385	417	439	455	538
HDV 60P	60							61.2	113	158	200	261	333	462	500	526	545	645
HDV 80P	80							81.6	151	211	267	348	444	615	667	702	727	860
HDV 100P	100							102	189	263	333	435	556	759	833	877	909	1070
HDV 120P	120							122	226	316	400	522	667	923	1000	1050	1090	1290
HDV 150P	150							153	283	395	500	652	833	1150	1250	1310	1360	1610
HDV 200P	200							204	377	526	667	870	1110	1530	1660	1750	1810	2150
HDV 250P	250							255	472	658	833	1080	1380	1920	2080	2190	2270	2680
HDV 300P	300							306	566	789	1000	1300	1660	2300	2500	2630	2720	3220
HDV 350P	350							357	660	921	1160	1520	1940	2690	2910	3070	3180	3760
HDV 400P	400							408	755	1050	1330	1730	2220	3070	3330	3500	3630	4300
HDV 450P	450							459	849	1180	1500	1950	2500	3460	3750	3940	4090	4830
HDH 10P	10	1.02	1.27	2.02	3.39	4.73	6.17	8.93	16.1	21.3	24.4	27.8	33.3	45.5	50	58.8	61.5	71.6
HDH 20P	20	2.04	2.54	4.04	6.78	9.43	12.4	17.9	32.3	42.6	48.8	55.6	66.7	90.9	100	118	125	143
HDH 30P	30	3.06	3.81	6.06	10.2	14.2	18.5	26.8	48.3	63.8	73.2	83.3	100	136	150	176	188	214
HDH 40P	40	4.08	5.08	8.08	13.6	18.9	24.7	35.7	64.5	85.1	97.6	111	133	182	200	235	250	286
HDH 50P	50	5.1	6.34	10.1	16.9	23.6	30.9	44.6	80.7	106	122	139	167	227	250	294	313	357
HDH 60P	60	6.12	7.61	12.1	20.3	28.3	37	53.6	96.8	128	146	167	200	273	300	353	375	429
HDH 80P	80	8.16	10.2	16.2	27.1	37.7	494	71.4	129	170	195	222	267	364	400	471	500	571
HDH 100P	100	10.2	12.7	20.2	33.9	47.2	61.7	89.3	161	213	244	278	333	455	500	588	625	714
HDH 120P	120	12.2	15.2	24.2	40.7	56.6	74.1	107	194	255	293	333	400	545	600	706	750	857
HDH 150P	150	15.3	19	30.3	50.8	70.8	92.6	134	242	319	366	417	500	682	750	882	938	1070
HDH 200P	200	20.4	25.4	40.4	67.8	94.3	123	179	323	426	488	556	667	909	1000	1180	1250	1420
HDH 250P	250	25.5	31.7	50.5	84.7	118	154	223	403	532	610	694	806	1000	1080	1190	1300	1450
HDH 300P	300	30.6	38.1	60.6	102	142	185	268	484	638	732	833	968	1200	1300	1420	1500	1660
HDH 350P	350	35.7	44.4	70.7	119	165	216	313	565	745	854	972	1120	1400	1520	1660	1750	1940
HDH 400P	400	40.8	50.8	80.8	136	189	247	357	645	851	976	1110	1290	1600	1730	1900	2000	2220
HDH 450P	450	45.9	57.1	90.9	153	212	278	402	726	957	1090	1250	1450	1800	1950	2140	2250	2500
HDH 500P	500	51	63.4	101	169	236	309	446	806	1060	1210	1380	1610	2000	2170	2380	2500	2770
HDH 600P	600	61.2	76.1	121	204	283	370	536	968	1270	1460	1660	1930	2400	2600	2850	3000	3330
HDH 700P	700	71.4	88.8	141	237	330	432	625	1120	1480	1700	1940	2250	2800	3040	3330	3500	3880
HDM 10P	10	1.02	1.26	2.01	3.33	4.85	6.17	8.2	12.0	13.8	15.1	16.6	18.1	21.7	23.8	25.0	27.7	37.0
HDM 20P	20	2.03	2.53	4.02	6.67	9.71	12.4	16.4	24.1	27.8	30.3	33.3	36.4	43.5	47.6	50.0	55.6	74.1
HDM 30P	30	3.05	3.79	6.03	10.00	14.60	18.5	24.6	36.1	41.0	45.5	50.0	54.6	65.2	71.4	75.0	83.3	111.0
HDM 40P	40	4.06	5.05	8.04	13.3	19.4	24.7	32.8	48.2	55	60.6	66.7	72.7	87	95.2	100	111	148
HDM 50P	50	5.08	6.31	10.1	16.7	24.3	30.9	41	60.2	69.4	75.8	83.3	90.9	109	119	125	139	185
HDM 60P	60	6.09	7.58	12.1	20	29.1	37	49.2	72.3	83.3	90.9	100	109	130	143	150	167	222
HDM 80P	80	8.12	10.1	16.1	26.7	38.8	49.4	65.6	96.4	111	121	133	145	174	190	200	222	296
HDM 100P	100	10.2	12.6	20.1	33.3	48.5	61.7	82	120	139	152	167	182	217	238	250	278	370
HDM 120P	120	12.2	15.2	24.1	40	58.3	74.1	98.4	145	167	182	260	218	261	286	300	333	444
HDM 150P	150	15.2	18.9	30.2	50	72.8	92.6	123	181	208	227	250	273	326	357	375	417	556
HDM 200P	200	20.3	25.3	40.2	66.7	97.1	123	164	241	278	303	333	364	435	476	500	556	741
HDM 250P	250	25.4	31.6	50.3	80.3	121	154	205	301	347	379	417	455	543	595	625	694	926
HDM 300P	300	30.5	37.9	60.3	100	146	185	246	361	417	455	500	545	652	714	750	833	1110
HDM 350P	350	35.5	44.2	70.4	117	170	216	287	422	486	530	583	636	761	833	875	972	1290
HDM 400P	400	40.6	50.5	80.4	133	194	247	328	482	556	606	667	727	870	952	1000	1110	1480
HDM 450P	450	45.7	56.8	90.5	150	218	278	369	542	625	682	750	818	78	1070	1120	1250	1660
HDM 500P	500	50.8	63.1	101	167	243	309	410	602	694	758	833	909	1080	1190	1250	1380	1850
HDM 600P	600	60.9	75.8	121	200	291	370	492	723	833	909	1000	1090	1300	1420	1500	1660	2220
HDM 700P	700	71.1	88.4	141	233	340	432	574	843	972	1060	1160	1270	1520	1660	1750	1940	2590
HDM 800P	800	81.1	101	161	267	388	494	656	964	1110	1210	1330	1450	1730	1900	2000	2220	2960
HDM 900P	900	91.4	114	181	300	437	556	738	1080	1250	1360	1500	1630	1950	2140	2250	2500	3330
HDM 1000P	1000	102	126	201	333	485	617	820	1200	1380	1510	1660	1810	2170	2380	2500	2770	3700
HDS 10P	10	1.01	1.26	2	3.13	4.26	5.08	6.25	8.2	9.01	9.71	10.5	11.6	13.7	14.3	15.2		
HDS 20P	20	2.02	2.51	4	6.25	8.51	10.2	12.5	16.4	18	19.4	21.3	24.7	32.3	35.1	37		
HDS 30P	30	3.03	3.77	6	9.38	12.8	15.2	18.8	24.6	27	29.1	31.9	37	48.4	52.6	55.6		
HDS 40P	40	4.04	5.03	8	12.5	17	20.3	25	32.8	36	38.8	42.6	49.4	64.5	70.2	74.1		
HDS 50P	50	5.05	6.28	10	15.6	21.3	25.4	31.3	41	45.1	48.5	53.2	61.7	80.7	87.8	92.6		
HDS 60P	60	6.06	7.54	12	18.8	25.5	30.5	37.5	49.2	54.1	58.3	63.8	74.1	96.8	105	111		
HDS 80P	80	8.08	10.1	16	25	34	40.6	50	65.6	72.1	77.7	85.1	98.8	129	140	148		
HDS 100P	100	10.1	12.6	20	31.3	42.6	50.8	62.5	82	90.1	97.1	106	123	161	175	185		
HDS 120P	120	12.1	15.1	24	37.5	51.1	60.9	75	98.4	108	117	128	148	194	211	222		
HDS 150P	150	15.2	18.8	30	46.9	63.8	76.1	93.8	123	135	146	160	185	242	263	278		
HDS 200P	200	20.2	25.1	40	62.5	85.1	102	125	164	180	194	213	247	323	351	370		
HDS 250P	250	25.3	31.4	50	78.1	106	127	156	205	225	243	263	291	342	357	379		
HDS 300P	300	30.3	37.7	60	93.8	128	152	188	246	270	291	316	349	411	429	455		
HDS 350P	350	35.4	44	70	109	149	178	219	287	315	340	368	407	479	500	530		
HDS 400P	400	40.4	50.3	80	125	170	203	250	328	360	388	421	465	548	571	606		
HDS 450P	450	45.5	56.5	90	141	191	228	281	369	405	437	474	523	616	643	682		
HDS 500P	500	50.5	62.8	100	156	213	254	313	410	450	485	526	581	685	714	758		
HDS 600P	600	60.6	75.4	120	188	255	305	375	492	541	583	632	698	822	857	909		
HDS 700P	700	70.7	87.9	140	219	298	355	438	574	631	680	737	814	959	1000	1060		
HDS 800P	800	80.8	101	160	250	340	406	500	656	721	777	842	930	1100	1140	1210		
HDS 900P	900	90.9	113	180	281	383	457	563	738	811	874	947	1050	1230	1290	1360		
HDS 1000P	1000	101	126	200	313	426	508	625	820	901	971	1050	1160	1370	1430	1520		

Table 8-4, Discharge End Voltage 1.06Vpc

8.2 Discharge Voltage, continued

Specifications are subject to change without notice.

END VOLTAGE 1.00V/CELL

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

CELL TYPE	C_5 Ah-1.10 V	Hours							Minutes						Seconds			
		10	8	5	3	2	1.5	1	30	20	15	10	5	1	30	15	5	1
HDV 10P	10							11.2	20.8	28.9	36.6	47.9	61.2	84.6	91.6	96.5	100.0	117.7
HDV 20P	20							22.44	41.47	57.86	73.37	95.7	122.1	169.4	183.7	192.5	200.2	236.5
HDV 30P	30							33.66	62.26	86.9	110	143	183.7	254.1	275	289.3	300.3	355.3
HDV 40P	40							44.88	83.05	115.5	146.3	191.4	244.2	338.8	366.3	386.1	400.4	473
HDV 50P	50							56.98	103.7	145.2	183.7	238.7	305.8	423.5	458.7	482.9	500.5	591.8
HDV 60P	60							67.32	124.3	173.8	220	287.1	366.3	508.2	550	578.6	599.5	709.5
HDV 80P	80							89.76	166.1	232.1	293.7	382.8	488.4	676.5	733.7	772.2	799.7	946
HDV 100P	100							112.2	207.9	289.3	366.3	478.5	611.6	834.9	916.3	964.7	999.9	1177
HDV 120P	120							134.2	248.6	347.6	440	574.2	733.7	1015	1100	1155	1199	1419
HDV 150P	150							168.3	311.3	434.5	550	717.2	916.3	1265	1375	1441	1496	1771
HDV 200P	200							224.4	414.7	578.6	733.7	957	1221	1683	1826	1925	1991	2365
HDV 250P	250							280.5	519.2	723.8	916.3	1188	1518	2112	2288	2409	2497	2948
HDV 300P	300							336.6	622.6	867.9	1100	1430	1826	2530	2750	2893	2992	3542
HDV 350P	350							392.7	726	1013	1276	1672	2134	2959	3201	3377	3498	4136
HDV 400P	400							448.8	830.5	1155	1463	1903	2442	3377	3663	3850	3993	4730
HDV 450P	450							504.9	933.9	1298	1650	2145	2750	3806	4125	4334	4499	5313
HDH 10P	10	1.122	1.397	2.222	3.729	5.203	6.787	9.823	17.71	23.43	26.84	30.58	36.63	50.05	55	64.68	67.65	78.76
HDH 20P	20	2.244	2.794	4.444	7.458	10.37	13.64	19.69	35.53	46.86	53.68	61.16	73.37	99.99	110	129.8	137.5	157.3
HDH 30P	30	3.366	4.191	6.666	11.22	15.62	20.35	29.48	53.13	70.18	80.52	91.63	110	149.6	165	193.6	206.8	235.4
HDH 40P	40	4.488	5.588	8.888	14.96	20.79	27.17	39.27	70.95	93.61	107.4	122.1	146.3	200.2	220	258.5	275	314.6
HDH 50P	50	5.61	6.974	11.11	18.59	25.96	33.99	49.06	88.77	116.6	134.2	152.9	183.7	249.7	275	323.4	344.3	392.7
HDH 60P	60	6.732	8.371	13.31	22.33	31.13	40.7	58.96	106.5	140.8	160.6	183.7	220	300.3	330	388.3	412.5	471.9
HDH 80P	80	8.976	11.22	17.82	29.81	41.47	543.4	78.54	141.9	187	214.5	244.2	293.7	400.4	440	518.1	550	628.1
HDH 100P	100	11.22	13.97	22.22	37.29	51.92	67.87	98.23	177.1	234.3	268.4	305.8	366.3	500.5	550	646.8	687.5	785.4
HDH 120P	120	13.42	16.72	26.62	44.77	62.26	81.51	117.7	213.4	280.5	322.3	366.3	440	599.5	660	776.6	825	942.7
HDH 150P	150	16.83	20.9	33.33	55.88	77.88	101.9	147.4	266.2	350.9	402.6	458.7	550	750.2	825	970.2	1032	1177
HDH 200P	200	22.44	27.94	44.44	74.58	103.7	135.3	196.9	355.3	468.6	536.8	611.6	733.7	999.9	1100	1298	1375	1562
HDH 250P	250	28.05	34.87	55.55	93.17	129.8	169.4	245.3	443.3	585.2	671	763.4	886.6	1100	1188	1309	1430	1595
HDH 300P	300	33.66	41.91	66.66	112.2	156.2	203.5	294.8	532.4	701.8	805.2	916.3	1065	1320	1430	1562	1650	1826
HDH 350P	350	39.27	48.84	77.77	130.9	181.5	237.6	344.3	621.5	819.5	939.4	1069	1232	1540	1672	1826	1925	2134
HDH 400P	400	44.88	55.88	88.88	149.6	207.9	271.7	392.7	709.5	936.1	1074	1221	1419	1760	1903	2090	2200	2442
HDH 450P	450	50.49	62.81	99.99	168.3	233.2	305.8	442.2	798.6	1053	1199	1375	1595	1980	2145	2354	2475	2750
HDH 500P	500	56.1	69.74	111.1	185.9	259.6	339.9	490.6	886.6	1166	1331	1518	1771	2200	2387	2618	2750	3047
HDH 600P	600	67.32	83.71	133.1	224.4	311.3	407	589.6	1065	1397	1606	1826	2123	2640	2860	3135	3300	3663
HDH 700P	700	78.54	97.68	155.1	260.7	363	475.2	687.5	1232	1628	1870	2134	2475	3080	3344	3663	3850	4268
HDM 10P	10	1.12	1.39	2.21	3.66	5.34	6.79	9.0	13.2	15.2	16.6	18.3	19.9	23.9	26.2	27.5	30.5	40.7
HDM 20P	20	2.23	2.78	4.42	7.34	10.68	13.6	18.0	26.5	30.6	33.3	36.6	40.0	47.9	52.4	55.0	61.2	81.5
HDM 30P	30	3.36	4.17	6.63	11.00	16.06	20.4	27.1	39.7	45.1	50.1	55.0	60.1	71.7	78.5	82.5	91.6	122.1
HDM 40P	40	4.466	5.555	8.844	14.63	21.34	27.17	36.08	53.0	60.5	66.66	73.37	79.97	95.7	104.7	110	122.1	162.8
HDM 50P	50	5.588	6.941	11.11	18.37	26.73	33.99	45.1	66.2	76.34	83.38	91.63	99.99	119.9	130.9	137.5	152.9	203.5
HDM 60P	60	6.699	8.338	13.31	22	32.01	40.7	54.12	79.5	91.63	99.99	110	119.9	143	157.3	165	183.7	244.2
HDM 80P	80	8.932	11.11	17.71	29.37	42.68	54.34	72.16	106.0	122.1	133.1	146.3	159.5	191.4	209	220	244.2	325.6
HDM 100P	100	11.22	13.86	22.11	36.63	53.35	67.87	90.2	132	152.9	167.2	183.7	200.2	238.7	261.8	275	305.8	407
HDM 120P	120	13.42	16.72	26.51	44	64.13	81.51	108.2	159.5	183.7	200.2	286	239.8	287.1	314.6	330	366.3	488.4
HDM 150P	150	16.72	20.79	33.22	55	80.08	101.9	135.3	199.1	228.8	249.7	275	300.3	358.6	392.7	412.5	458.7	611.6
HDM 200P	200	22.33	27.83	44.22	73.37	106.8	135.3	180.4	265.1	305.8	333.3	366.3	400.4	478.5	523.6	550	611.6	815.1
HDM 250P	250	27.94	34.76	55.33	88.33	133.1	169.4	225.5	331.1	381.7	416.9	458.7	500.5	597.3	654.5	687.5	763.4	1019
HDM 300P	300	33.55	41.69	66.33	110	160.6	203.5	270.6	397.1	458.7	500.5	550	599.5	717.2	785.4	825	916.3	1221
HDM 350P	350	39.05	48.62	77.44	128.7	187	237.6	315.7	464.2	534.6	583	641.3	699.6	837.1	916.3	962.5	1069	1419
HDM 400P	400	44.66	55.55	88.44	146.3	213.4	271.7	360.8	530.2	611.6	666.6	733.7	799.7	957	1047	1100	1221	1628
HDM 450P	450	50.27	62.48	99.55	165	239.8	305.8	405.9	596.2	687.5	750.2	825	899.8	85.8	1177	1232	1375	1826
HDM 500P	500	55.88	69.41	111.1	183.7	267.3	339.9	451	662.2	763.4	833.8	916.3	999.9	1188	1309	1375	1518	2035
HDM 600P	600	66.99	83.38	133.1	220	320.1	407	541.2	795.3	916.3	999.9	1100	1199	1430	1562	1650	1826	2442
HDM 700P	700	78.21	97.24	155.1	256.3	374	475.2	631.4	927.3	1069	1166	1276	1397	1672	1826	1925	2134	2849
HDM 800P	800	89.21	111.1	177.1	293.7	426.8	543.4	721.6	1060	1221	1331	1463	1595	1903	2090	2200	2442	3256
HDM 900P	900	100.5	125.4	199.1	330	480.7	611.6	811.8	1188	1375	1496	1650	1793	2145	2354	2475	2750	3663
HDM 1000P	1000	112.2	138.6	221.1	366.3	533.5	678.7	902	1320	1518	1661	1826	1991	2387	2618	2750	3047	4070
HDS 10P	10	1.111	1.386	2.2	3.443	4.686	5.588	6.875	9.02	9.911	10.68	11.55	12.76	15.07	15.73	16.72		
HDS 20P	20	2.222	2.761	4.4	6.875	9.361	11.22	13.75	18.04	19.8	21.34	23.43	27.17	35.53	38.61	40.7		
HDS 30P	30	3.333	4.147	6.6	10.32	14.08	16.72	20.68	27.06	29.7	32.01	35.09	40.7	53.24	57.86	61.16		
HDS 40P	40	4.444	5.533	8.8	13.75	18.7	22.33	27.5	36.08	39.6	42.68	46.86	54.34	70.95	77.22	81.51		
HDS 50P	50	5.555	6.908	11	17.16	23.43	27.94	34.43	45.1	49.61	53.35	58.52	67.87	88.77	96.58	101.9		
HDS 60P	60	6.666	8.294	13.2	20.68	28.05	33.55	41.25	54.12	59.51	64.13	70.18	81.51	106.5	115.5	122.1		
HDS 80P	80	8.888	11.11	17.6	27.5	37.4	44.66	55	72.16	79.31	85.47	93.61	108.7	141.9	154	162.8		
HDS 100P	100	11.11	13.86	22	34.43	46.86	55.88	68.75	90.2	99.11	106.8	116.6	135.3	177.1	192.5	203.5		
HDS 120P	120	13.31	16.61	26.4	41.25	56.21	66.99	82.5	108.2	118.8	128.7	140.8	162.8	213.4	232.1	244.2		
HDS 150P	150	16.72	20.68	33	51.59	70.18	83.71	103.2	135.3	148.5	160.6	176	203.5	266.2	289.3	305.8		
HDS 200P	200	22.22	27.61	44	68.75	93.61	112.2	137.5	180.4	198	213.4	234.3	271.7	355.3	386.1	407		
HDS 250P	250	27.83	34.54	55	85.91	116.6	139.7	171.6	225.5	247.5	267.3	289.3	320.1	376.2	392.7	416.9		
HDS 300P	300	33.33	41.47	66	103.2	140.8	167.2	206.8	270.6	297	320.1	347.6	383.9	452.1	471.9	500.5		
HDS 350P	350	38.94	48.4	77	119.9	163.9	195.8	240.9	315.7	346.5	374	404.8	447.7	526.9	550	583		
HDS 400P	400	44.44	55.33	88	137.5	187	223.3	275	360.8	396	426.8	463.1	511.5	602.8	628.1	666.6		
HDS 450P	450	50.05	62.15	99	155.1	210.1	250.8	309.1	405.9	445.5	480.7	521.4	575.3	677.6	707.3	750.2		
HDS 500P	500	55.55	69.08	110	171.6	234.3	279.4	344.3	451	495	533.5	578.6	639.1	753.5	785.4	833.8		
HDS 600P	600	66.66	82.94	132	206.8	280.5	335.5	412.5	541.2	595.1	641.3	695.2	767.8	904.2	942.7	999.9		
HDS 700P	700	77.77	96.69	154	240.9	327.8	390.5	481.8	631.4	694.1	748	810.7	895.4	1055	1100	1166		
HDS 800P	800	88.88	111.1	176	275	374	446.6	550	721.6	793.1	854.7	926.2	1023	1210	1254	1331		
HDS 900P	900	99.99	124.3	198	309.1	421.3	502.7	619.3	811.8	892.1	961.4	1042	1155	1353	1419	1496		
HDS 1000P	1000	111.1	138.6	220	344.3	468.6	558.8	687.5	902	991.1	1068	1155	1276	1507	1573	1672		

Table 8-5, Discharge End Voltage 1.0Vpc

8.2 Discharge Voltage, continued

Specifications are subject to change without notice.

Very High-Rate Type HDV-P

Cell Type		Minutes 2	1.5	1	Seconds 45	30	15	5	1
HDV	20 P	213	228	242	253	264	274	295	319
HDV	30 P	319	342	363	379	397	411	442	479
HDV	40 P	426	455	484	505	529	548	590	639
HDV	50 P	532	569	605	632	661	685	737	799
HDV	60 P	639	683	726	758	793	821	885	958
HDV	80 P	852	911	968	1011	1057	1095	1179	1278
HDV	100 P	1065	1139	1211	1264	1322	1369	1474	1597
HDV	120 P	1278	1366	1453	1516	1586	1643	1769	1917
HDV	150 P	1597	1708	1816	1896	1983	2054	2212	2396
HDV	200 P	2130	2277	2421	2527	2644	2738	2949	3194
HDV	250 P	2662	2847	3026	3159	3305	3423	3686	3993
HDV	300 P	3194	3416	3632	3791	3966	4107	4423	4792
HDV	350 P	3727	3985	4237	4423	4626	4792	5160	5590
HDV	400 P	4259	4554	4842	5055	5287	5476	5897	6389
HDV	450 P	4792	5124	5447	5687	5948	6161	6635	7188

Very High-Rate Type HDH-P

Cell Type		Minutes 2	1.5	1	Seconds 45	30	15	5	1
HDH	20 P	122	131	144	152	162	177	198	213
HDH	30 P	184	197	216	228	243	265	297	319
HDH	40 P	245	263	288	305	324	354	397	426
HDH	50 P	306	329	359	381	405	442	496	532
HDH	60 P	367	394	431	457	486	531	595	639
HDH	80 P	489	526	575	609	648	708	793	852
HDH	100 P	612	657	719	762	810	885	991	1065
HDH	120 P	734	789	863	914	972	1062	1190	1278
HDH	150 P	918	986	1078	1142	1215	1327	1487	1597
HDH	200 P	1223	1314	1438	1523	1620	1769	1983	2130
HDH	250 P	1337	1402	1513	1580	1672	1797	2478	2662
HDH	300 P	1605	1683	1816	1896	2006	2156	2974	3194
HDH	350 P	1872	1963	2118	2212	2340	2516	3470	3727
HDH	400 P	2140	2244	2421	2527	2674	2875	3966	4259
HDH	450 P	2407	2524	2724	2843	3009	3234	4461	4792
HDH	500 P	2674	2805	3026	3159	3343	3594	4957	5324
HDH	600 P	3209	3366	3632	3791	4012	4313	5948	6389
HDH	700 P	3744	3927	4237	4423	4680	5031	6940	7454

Table 8-6, Discharge End Voltage 0.9Vpc

Very High-Rate Type HDV-P

Cell Type		Minutes 2	1.5	1	Seconds 45	30	15	5	1
HDV	20 P	315	343	371	383	404	418	426	460
HDV	30 P	473	515	556	575	605	627	639	690
HDV	40 P	630	687	742	767	807	836	852	920
HDV	50 P	788	858	927	958	1009	1045	1065	1150
HDV	60 P	945	1030	1113	1150	1211	1255	1278	1380
HDV	80 P	1260	1373	1484	1533	1624	1673	1704	1840
HDV	100 P	1575	1716	1855	1917	2018	2091	2130	2300
HDV	120 P	1890	2060	2226	2300	2421	2509	2556	2760
HDV	150 P	2363	2575	2782	2875	3026	3136	3194	3450
HDV	200 P	3151	3433	3710	3833	4035	4182	4259	4600
HDV	250 P	3938	4291	4637	4792	5044	5227	5324	5750
HDV	300 P	4726	5149	5565	5750	6053	6273	6389	6900
HDV	350 P	5514	6007	6492	6708	7061	7318	7454	8050
HDV	400 P	6301	6866	7419	7667	8070	8364	8519	9200
HDV	450 P	7089	7724	8347	8625	9079	9409	9583	10350

Very High-Rate Type HDH-P

Cell Type		Minutes 2	1.5	1	Seconds 45	30	15	5	1
HDH	20 P	184	197	217	230	240	264	291	311
HDH	30 P	276	295	325	345	359	397	437	466
HDH	40 P	368	393	434	460	479	529	582	622
HDH	50 P	460	491	542	575	599	661	728	777
HDH	60 P	552	590	651	690	719	793	873	932
HDH	80 P	736	786	868	920	958	1057	1165	1243
HDH	100 P	920	983	1085	1150	1198	1322	1456	1554
HDH	120 P	1104	1179	1302	1380	1438	1586	1747	1865
HDH	150 P	1380	1474	1627	1725	1797	1983	2184	2331
HDH	200 P	1840	1966	2170	2300	2396	2644	2911	3108
HDH	250 P	1917	2054	2212	2337	2457	2662	3639	3885
HDH	300 P	2300	2464	2654	2805	2949	3194	4367	4662
HDH	350 P	2683	2875	3096	3272	3440	3727	5095	5439
HDH	400 P	3067	3286	3538	3740	3932	4259	5823	6216
HDH	450 P	3450	3696	3981	4207	4423	4792	6551	6993
HDH	500 P	3833	4107	4423	4675	4915	5324	7278	7770
HDH	600 P	4600	4929	5308	5610	5897	6389	8734	9324
HDH	700 P	5367	5750	6192	6545	6880	7454	10190	10878

Table 8-7, Discharge End Voltage 0.7Vpc

Power

Alpha Technologies

Alpha Industrial Power, Inc
1075 Satellite Blvd. Suite 400
Suwanee, GA 30024
USA
Tel: +1 678 475 3995
Fax: +1 678 584 9259

Alpha Technologies
3767 Alpha Way
Bellingham, WA 98226
USA
Tel: +1 360 647 2360
Fax: +1 360 671 4936
Web: www.alpha.com

Alpha Technologies Ltd.
4084 McConnell Court
Burnaby, BC, V5A 3N7
CANADA
Tel: +1 604 430 1476
Fax: +1 604 430 8908

Alpha Technologies
Europe Ltd.
Twyford House
Thorley
Bishop's Stortford
Hertfordshire
CM22 7PA
UNITED KINGDOM
Tel: +44 1279 501110
Fax: +44 1279 659870

Alpha Technologies GmbH
Hansastrasse 8
D-91126 Schwabach
GERMANY
Tel: +49 9122 79889 0
Fax: +49 9122 79889 21

Alphatec, Ltd
P.O. Box 56468
Limassol, Cyprus
CYPRUS
Tel: +357 25 375675
Fax: +357 25 359595

AlphaTEK ooo
Khokhlovskiy Pereulok 16
Stroenie 1, Office 403
109028 Moscow
RUSSIA
Tel: +7 495 916 1854
Fax: +7 495 916 1349

Alphatec Baltics
S. Konarskio G. 48
Vilnius 2009
LITHUANIA
Tel: +370 5 213 8822
Fax: +370 5 213 7799

Alpha Technologies
9 impasse Sans Souci
92140 Clamart France
FRANCE
Tel: +33 1 41 90 07 07
Fax: +33 1 41 90 93 12