Nickel Cadmium Clear Case

Pocket Plate Battery



Installation and Operation Manual Nickel Cadmium Clear Case Battery

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Alpha Technologies



Nickel Cadmium Clear Case

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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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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 77°F (25°C).
- 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 1.21/68°F (1.21/20°C) is ideal. While specific gravity values ranging from 1.16–1.23 at 68°F (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 1.8°F (1°C) below 68°F (20°C) and decreases by 0.0005 per 1.8°F (1°C) above 68°F (20°C).
- While mixing or storing electrolyte, use a vessel made of glass, porcelain steel, antialkaline 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.

2.0 Electrolyte, continued

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 1.16/68°F (1.16/20°C).
- 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 0.6-0.8 Vpc at a 5 hour rate current (C_s).
- 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.

Pre-Charge Preparation 3.1

- 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.

7.0 Forms. continued

Discharge Recording Form

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

Cell #	Inital Voltage								
		15min	30min	1hr	2hr	3hr	4hr	4:30hr	5 hr

8.0 Specifications

8.1 General Specifications

Specifications provided courtesy of Alpha Industrial Power (AIP) and have not been verified by Alpha Technologies.

HDM-P (E)

HDS-P (E)

	Cell	Туре	1	Dimensi	on(mm))))incl. olyte	yte(£)
Vented	type	Sealed type	H Vented	i Sealed	w	L	Wgt(kg)incl electrolyte	Electrolyte(£)
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 80PE	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

	Cell Type *			Dimensio)	Ngt(kg)inci electrolyte	yte(£)
Vente	ed type	Sealed type		H Vented	Sealed	w	L	Ngt(ke	Electrolyte(£)
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))incl. blyte	yte(£)
Vente	d type	Seale	d type		ł Vented	- Sealed	w	L	Wgt(kg)incl electrolyte	Electrolyte(£
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	ν,	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)

	Celi	Туре				Dimensio	on(mm)		g)incl. olyte	lyte(£)
Vented	type	Sealed	d type		H Vented	<u> </u>	w	L	Wgt(kg)incl. electrolyte	Electrolyte(#)
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	нрн	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 provided courtesy of Alpha Industrial Power (AIP) and have not been verified by Alpha Technologies.

END	VOLI	AGE 1.	14V/C	ELL								SPECIFIC		SUBJE	ст то с	HANGE			CE
CE		C ₅	10	8	5	Hours 3	2	1.5	1	30	20	Minu 15	ites 10	5	1	30	Seco 15	nds 5	1
TY HDV	10P	Ah-1.10 V 10	10	0	- 5	3		1.5	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	111 167	116 174	118 176	154 231
HDV	30P	30							27.8 37	48.4	62.5 83.3	75	93.8 125	115	158 211	222	233	235	308
HDV HDV	40P 50P	40 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 92.6	129 161	167 208	200 250	250 313	308 385	421 526	444 556	465 581	471 588	615 769
HDV HDV	100P 120P	100 120							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 1530
HDV	200P	200							185 231	323 403	417 521	500 625	625 781	769 962	1050 1310	1110 1380	1160 1450	1170 1470	1920
HDV HDV	250P 300P	250 300							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							370 417	645 726	833 938	1000 1120	1250 1400	1530 1730	2100 2360	2220 2500	2320 2610	2350 2640	3070 3460
HDV HDH	450P	450 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 58.8	50 66.7	58.8 78.4	69.8 93.8	93.8 125	103	111	125	150 200
HDH HDH	40P 50P	40 50	4.04 5.05	5.03 6.28	8 10	14.7	20.3	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 50.8	55.6 69.4	94.1 118	118 147	133 167	157 196	186 233	250 313	276 345	296 370	333 417	400 500
HDH HDH	100P 120P	100 120	10.1 12.1	12.5 15.1	20 24	29.4 35.3	40.7 48.8	50.8 60.9	69.4 83.3	141	176	200	235	233	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	294 368	333 417	392 481	465 543	625 658	690 714	741 781	833 850	1000 1050
HDH	250P 300P	250 300	25.3 30.3	31.4	<u>50</u> 60	73.5 88.2	102	127	174	294 353	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	667 750	769	870 978	1050	1140 1280	1250	1330 1500	1530 1730
HDH HDH	450P 500P	450 500	45.5 50.5	56.5 62.8	90 100	132 147	183 203	228 254	313 347	529 588	662 735	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 HDM	10P 20P	10 20	0.97	1.20 2.41	1.89 3.77	2.82 5.63	3.76 7.52	4.55 9.09	5.92 11.80	8.47	9.90 19.80	10.80 21.50	11.70 23.50	12.50 25.00	14.70 29.40	15.60 31.30	16.30 32.80	17.80 35.70	27.70 55.60
HDM	20P 30P	30	2.91	3.61	5.66	8.45	11.30	13.60	17.80	25.40	29.70	32.30		37.50	44.10	46.90		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 HDM	50P 60P	50 60	4.85 5.83	6.02 7.23	9.43 11.3	14.1 16.9	18.8 22.6	22.7 27.3	29.6 35.5	42.4 50.9	49.5 59.4	53.8 64.5	58.8 70.6	62.5 75	73.5 88.2	78.1 93.8	820 98.4	89.3 107	139 167
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 150P	120	11.7	14.5	22.6	33.8 42.3	45.1	54.6 68.2	71 88.8	102	119	129	141	150 188	221	188	197 246	214	333
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 HDM	300P 350P	300 350	29.1 34	361 42.2	56.6 66	84.5 98.6	113 132	136 159	178 207	254 297	297 347	323 376	353 412	375 438	441 515	469 547	492 572	536 625	833 972
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 600P	500 600	48.5 58.3	60.2 72.3	94.3 113	141 169	188 226	227 273	296 355	424 508	495 594	538 645	588 706	625 750	735 882	781 938	820 984	893 1070	1380 1660
HDM 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 HDM	900P 1000F	900 1000	87.4 97.1	108 120	170 189	254 282	338 376	409 455	533 592	763 847	891 990	968 1080	1050 1170	1120 1250	1320 1470	1400	1470 1630	1600 1780	2500 2770
HDM	1000F	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		2.10
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 4.6	5.26	7.14 9.52	8.98	10.5	13	17.2	19.1 25.5	20.4	22.1 29.4	25.2 33.6	31.9 42.6	35.3	38		
HDS HDS	40P 50P	40 50	4.67	4.6 575	8.77	9.52 11.9	15	17.5	21.7	28.7	25.5	34	29.4 36.8	42	42.0 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 35	34.6	46 57.5	51 63.7	54.4 68	58.8 73.5	67.2 84	85.1 106	94.1	101 127		
HDS HDS	100P 120P	100	9.35	11.5 13.8	17.5 21.1	23.8 28.6	29.9 35.9	42	43.3 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	147 179	168 194	213 234	235 248	253 260		
HDS HDS	250P 300P	250 300	23.4	28.7 34.5	43.9	59.5 71.4	74.9	87.4	108	144	159	<u>167</u> 200	214	233	234	248	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 500P	450 500	42.1	51.7 57.5	79 87.7	107 119	135 150	157 175	195 216	259 287	287 318	300 333	321 357	349 388	421 467	446 495	469 521		
HDS HDS	600P	600	561	69 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		74.8	92	140	190	240	280	346	460	510 572	533	571	620	748 841	792 909	833 938		
HDS	900P 1000F	1	84.1 93.5	103 115	158 175	214 238	270 299	315 350	290 433	517 575	573 637	600 667	643 714	698 775	935	909	938 1049		
100	10001	1	55.5	. 10		200	200												

Table 8-2, Discharge End Voltage 1.14Vpc

8.2 Discharge Voltage, continued

Specifications provided courtesy of Alpha Industrial Power (AIP) and have not been verified by Alpha Technologies.

CELL	TAGE 1.	1		_	Hours						Min	utes	S SUBJ			Seco	onds	
TYPE	Ah-1.10 V	10	8	5	3	2	1.5	1	30	20	15	10	5	1	30	15	5	1
HDV IOP	10							9.6	17.5	23.8 47.6	29.4 58.8	37.0 74.1	455.0 90.9	58.8 118	66.7 133	69.0 138	71.4 143	89.3 179
HDV 20P HDV 30P	20							19.2 28.9	35.1 52.6	71.4	88.2	111	136	176	200	207	214	268
HDV 30P 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	357 429	446 536
HDV 60P	60	<u> </u>						57.7 76.9	105	143	235	222 296	273	353 471	400 533	414 552	571	714
HDV 80P HDV 100F	80							96.2	175	238	294	370	455	588	667	690	714	893
HDV 120	1							115	211	286	353	444	545	706	800	828	857	107
HDV 150	1				_			144	263	357	441	556	682	882 1170	1000	1030 1380	1070 1420	133
HDV 200F	1							192 240	351 439	476 595	588 735	741 926	909 1130	1470	1660	1720	1780	223
HDV 2500 HDV 3000								288	526	714	882	1110	1360	1760	2000	2070	2140	267
HDV 350								337	614	833	1020	1290	1590	2050	2330	2410	2500	312
HDV 400								385	702	952	1170 1320	1480	1810 2040	2350 2640	2660	2760 3100	2850 3210	357 401
HDV 450		1 02	1.26	2.01	3.17	4.37	5.56	433	789	1070	20.8	1660 25	29.4	38.5	41.7	45.5	50.5	58.
HDH 10P HDH 20P	10 20	1.02	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 7.58	10.1	15.9 19	21.8 26.2	27.8 33.3	38.8 46.5	68.5 82.2	89.3 107	104 125	125 150	147 176	192 231	206 250	227 2 7 3	250 300	294 353
HDH 60P	60 80	6.09 8.12	10.1	12.1	25.4	349	44.4	62	110	143	167	200	235	308	333	364	400	47
HDH 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 120	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 150		15.2	18.9	30.2 40.2	47.6 63.5	65.5 87.3	83.3 111	116 155	205 274	268 357	313 417	375 500	441 588	577 769	625 833	682 909	750 1000	882
HDH 2008 HDH 2508		20.3	25.2 31.6	40.2 50.3	63.5 794	87.3 109	139	194	342	357 446	521	581	588 676	833	893	909 962	1040	119
HDH 300		30.5	37.9	60.3	95.2	131	167	233	411	536	625	698	811	1000	1070	1150	1250	142
HDH 350		35.5	44.2	70.4	111	153	194	271	479	625	729	814	946	1160	1250	1340	1450	166
HDH 400		40.6	50.5 56.8	80.4	127	175 197	222	310 349	548 616	714 804	833 938	930 1040	1080	1330 1500	1420	1530	1660	190 214
HDH 4501 HDH 5001	1	50.8	63.1	101	143	218	250	388	685	893	1040	1160	1350	1660	1780	1920	2080	238
HDH 600		60.9	75.8	121	190	262	333	465	822	1070	1250	1390	1620	2000	2140	2300	2500	285
HDH 700	-	71.1	88.4	141	222	306	389	543	959	1250	1450	1620	1890	2330	2500	2690	2910	333
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.
HDM 20P HDM 30P	20	2.02	2.51 3.77	4.00 6.00	6.25 9.38	8.51 12.80	10.6 15.9	13.8 20.7	20.0	23.3 34.9	25.6 38.5	28.6 42.9	31.3 46.9	37.0 55.6	39.2 58.8	42.6 63.8	45.5 68.2	62.1 93.1
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 HDM 100F	80	8.08	10.1 12.6	16 20	25 31.3	34 42.6	42.3 52.9	55.2 69	80.0	93 116	103 128	114 143	125 156	148 185	157 196	170 213	182 227	250 313
HDM 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 150	1	15.2	18.8	30	46.9	63.8	79.4	103	150	174	192	214	234	278	294	319	341	469
HDM 200		20.2	25.1	40	62.5	85.1	106	138	200	233	256	286	313	370	392	426	455	625
HDM 250F		25.3	31.4	50 60	78.1 93.8	106	132	207	250	291 349	321 385	357	391 469	463 556	490 588	532 638	568 682	781 938
HDM 350F		35.4	44	70	109	149	185	241	350	407	449	500	547	648	686	745	795	109
HDM 400F	400	40.4	50.3	80	125	170	212	276	400	465	513	571	625	741	784	851	909	125
HDM 450P		45.5	56.5	90	141	191	238	310	450	523	577	643	703	833	882	957	1020	140
HDM 500F HDM 600F		50.5 60.6	62.8 75.4	100 120	156 188	213 255	265 317	345 414	500 600	581 698	641 769	714 857	781 938	926	980	1060	1130	156
HDM 700F		70.7	87.9	140	219	298	370	483	700	814	897	1000	1090	1110	1170 1370	1270	1360 1590	187
HDM 800F	800	80.8	101	160	250	340	423	552	800	934	1020	1140	1250	1480	1560	1700	1810	250
HDM 900F		90.9	113	180	281	383	476	621	900	1040	1150	1280	1400	1660	1760	1910	2040	281
HDM 1000 HDS 10P	P 1000 10	101	126	200	313 2.7	426	529 4.15	690 5.15	1000 6.67	1160 7.58	1280	1420 8.55	1560 9.35	1850	1960		2270	312
HDS TOP	20	1.94	2.41	3.77	5.41	3.5 6.99	8.3	5.15 10.3	13.3	15.2	8.06 16.1	8.55	9.35 20.2	26	11.7 28.2	12.1 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 HDS 60P	50 60	4.85 5.83	6.02 7.23	9.43 11.3	13.5 16.2	17.5 21	20.8 24.9	25.8 30.9	33.3 40	37.9	40.3 48.4	43.5 52.2	50.5 60.6	64.9	70.4	75.8		
HDS 60P	80	777	9.64	11.3	21.6	21	33.2	41.2	53.3	45.5	48.4	52.2 69.6	80.8	77.9	84.5 113	90.9 121		
HDS 1008		9.71	12.1	18.9	27	35	41.5	51.6	66.7	75.8	80.7	87	101	130	141	152		
HDS 120F		11.7	14.5	22.6	32.4	42	49.8	61.9	80	90.9	96.8	104	121	156	169	182		
HDS 150F		14.6	18.1	28.3	40.5	52.5	62.2	77.3	100	114	121	130	152	195	211	227		
HDS 200F HDS 250F		19.4 24.3	24.1 30.1	37.7 47.2	54.1 67.6	69.9 87.4	83 104	103 129	133 167	152 189	161 202	174 214	202 234	260 278	282 294	303 305		
HDS 300F		29.1	36.1	56.6	81.1	105	124	155	200	227	242	256	280	333	353	366		
HDS 350F	350	34	42.2	66	94.6	122	145	180	233	265	282	299	327	389	412	427		
HDS 400F	400	38.8	48.2	75.5	108	140	166	206	267	303	323	342	374	444	471	488		
HDS 450F		43.7	54.2	84.9	122	157	187	232	300	341	363	385	421	500	529	549		
HDS 500F HDS 600F	1	78.5	60.2 72.3	94.3 113	135 162	175 210	207 249	258 309	333 400	379 455	403 484	427 513	467 561	556 667	588 706	610 732		
HDS 700F		68	84.3	132	189	245	290	361	467	530	565	598	654	778	824	854		
HDS 800F		77.7	96.4	151	216	280	332	412	533	606	645	684	748	889	941	976		
HD\$ 900F	900	87.4	108	170	243	315	373	464	600	682	726	769	841	1000	1050	1090		
HDS 1000	P 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 provided courtesy of Alpha Industrial Power (AIP) and have not been verified by Alpha Technologies.

END	VOLT	AGE 1.	06V/C	ELL			_					SPECIFI	CATION	S SUBJI	ест то	CHANG	e witho	UT NO	FICE
CE TY		C ₅ Ah-1.10 V	10	8	5	Hours 3	2	1.5	1	30	20	Minu 15	utes 10	5	1	30	Seco 15	onds 5	1
HDV	IOP	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 HDV	30P 40P	30 40							30.6 40.8	56.6 75.5		100	130	167	231 308	250 333	263 351	273 364	323 430
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 HDV	80P 100P	80 100							81.6 102	151 189	211 263	267 333	348 435	444 556	615 759	667 833	702 877	727 909	860 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 HDV	200P 250P	200 250							204 255	377 472	526 658	667 833	870 1080	1110 1380	1530 1920	1660 2080	1750 2190	1810 2270	2150 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 HDV	400P 450P	400 450							408 459	755 849	1050 1180	1330 1500	1730 1950	2220 2500	3070 3460	3330 3750	3500 3940	3630 4090	4300 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 HDH	30P 40P	30 40	3.06	3.81 5.08	6.06 8.08	10.2	14.2 18.9	18.5	26.8	48.3 64.5	63.8 85.1	73.2 97.6	83.3	100	136	150 200	176 235	188	214 286
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
НОН НОН	80P 100P	80 100	8.16 10.2	10.2 12.7	16.2 20.2	27.1 33.9	37.7 47.2	494 61.7	71.4 89.3	129 161	170 213	195 244	222 278	267 333	364 455	400 500	471 588	500 625	571 714
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	319 426	366 488	417 556	500 667	682 909	750 1000	882 1180	938 1250	1070 1420
HDH HDH	200P 250P	200 250	20.4 25.5	25.4 31.7	40.4 50.5	67.8 84.7	94.3 118	123 154	179 223	323 403	426 532	488 610	556 694	806	1000	1080	1190	1300	1420
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 80.8	119 136	165 189	216 247	313 357	565 645	745 851	854 976	972 1110	1120 1290	1400 1600	1520	1660 1900	1750 2000	1940 2220
HDH HDH	400P 450P	400 450	40.8 45.9	50.8 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 700P	600 700	61.2 71.4	76.1 88.8	121 141	204 237	283 330	370 432	536 625	968 1120	1270 1 48 0	1460 1700	1660 1940	1930 2250	2400 2800	2600	2850 3330	3000 3500	3330 3880
HDH 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 40P	30 40	3.05	3.79	6.03 8.04	10.00	14.60 19.4	18.5	24.6	36.1	41.0 55	45.5 60.6	50.0 66.7	54.6 72.7	65.2 87	71.4 95.2	75.0	83.3	111.0 148
HDM HDM	40P	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
MOH HDM	80P 100P	80	8.12	10.1 12.6	16.1 20.1	26.7 33.3	38.8 48.5	49.4 61.7	65.6 82	96.4 120	111 139	121 152	133 167	145 182	174 217	190 238	200 250	222 278	296 370
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 HDM	200P 250P	200 250	20.3	25.3 31.6	40.2 50.3	66.7 80.3	97.1 121	123 154	164 205	241 301	278 347	303 379	333 417	364 455	435 543	476 595	500 625	556 694	741 926
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	636 727	761	833	875	972 1110	1290 1480
HDM HDM	400P 450P	400	40.6	50.5 56.8	80.4 90.5	133	194 218	247	328 369	482	556 625	606	667 750	818	870 78	952 1070	1000	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	291 340	370 432	492 574	723 843	833 972	909 1060	1000	1090 1270	1300 1520	1420 1660	1500	1660	2220 2590
HDM HDM	700P 800P	700 800	71.1	88.4 101	141 161	233	340 388	432 494	574 656	964	972 1110	1210	1330	1450	1730	1900	2000	2220	2990 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 8.2	1380 9.01	1510 9.71	1660 10.5	1810	2170	2380 14.3	2500	2770	3700
HDS HDS	10P 20P	10 20	1.01	1.26 2.51	2 4	3.13 6.25	4.26 8.51	5.08 10.2	6.25 12.5	16.4	18	9.71 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 15.6	17	20.3 25.4	25 31.3	32.8	36 45.1	38.8 48.5	42.6 53.2	49.4 61.7	64.5 80.7	70.2 87.8	74.1 92.6		
HDS HDS	50P 60P	50 60	5.05 6.06	6.28 7.54	10 12	18.8	21.3 25.5	25.4 30.5	37.5	49.2	45.1 54.1	48.5 58.3	63.8	74.1	96.8	105	92.0 111		
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 15.1	20 24	31.3 37.5	42.6 51.1	50.8 60.9	62.5 75	82 98.4	90.1 108	97.1 117	106 128	123 148	161 194	175	185 222		
HDS HDS	120P 150P	120	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	250 300	25.3	31.4	50 60	78.1	106	127	156 188	205	225	243	263	291 349	342	357 429	379 455		
HDS HDS	300P 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 62.9	90	141	191 213	228	281	369	405 450	437 485	474 526	523 581	616 685	643 714	682 758		
HDS HDS	500P 600P	500 600	50.5 60.6	62.8 75.4	100 120	156 188	213 255	254 305	313 375	410	450 541	485 583	526 632	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 HDS	900P 1000P	900 1000	90.9	113 126	180 200	281 313	383 426	457 508	563 625	738	811 901	874 971	947 1050	1050 1160	1230 1370	1290 1430	1360 1520		
103	1000F	1,000		,20	200	010													

Table 8-4, Discharge End Voltage 1.06Vpc

8.2 Discharge Voltage, continued

Specifications provided courtesy of Alpha Industrial Power (AIP) and have not been verified by Alpha Technologies.

HDV HDV HDV HDV HDV HDV HDV HDV HDV HDV	PE IOP 20P 30P 40P 50P 80P 100P 2009 2009 2009 2009 2009 2009 250P 2009 300P 300P 300P 300P 200P 300P	Cs Ah-1.10 V 10 20 30 40 50 60 80 100 20 30 40 50 300 350 450 10 20 300 350 400 50 60 80 100 200 250 300 350 400 50 60 80 100 200 200 200 250 300 350	2.244 3.366 4.488 5.61 6.732 8.976 11.22 13.42 16.83 22.44	2.794 4.191 5.588 6.974 8.371 11.22	5 2.222 4.44 6.666 8.688 11.11 13.31 7.82 22.22	7.458 11.22 14.96 18.59 22.33	10.37 15.62 20.79 25.96	13.64 20.35 27.17	44.88 56.98 67.32 89.76 112.2 134.2 168.3 224.4 280.5 336.6 392.7 448.8 504.9 9.823 19.69 29.48	62.26 83.05 103.7 124.3 166.1 207.9 248.6 311.3 414.7 519.2 622.6 726 830.5 933.9 17.71 35.53	145.2 173.8 232.1 289.3 347.6 434.5 578.6 723.8 867.9 1013 1155 1298 23.43 46.86	110 146.3 183.7 220 293.7 366.3 440 550 733.7 916.3 1100 1276 1463 1650 26.84 53.68	10 47.9 95.7 143 191.4 238.7 287.1 382.8 478.5 574.2 717.2 957 1188 1430 1672 1903 2145 30.58	5 61.2 122.1 183.7 244.2 305.8 366.3 488.4 611.6 733.7 916.3 1221 1518 1826 2134 2442 2750 36.63 73.37	254.1 338.8 423.5 508.2 676.5 834.9 1015 1265 1683 2112 2530 2959 3377 3806 50.05	458.7 550 733.7 916.3 1100 1375 1826 2288 2750 3201 3663 4125 55	289.3 386.1 482.9 578.6 772.2 964.7 1155 1441 1925 2409 2893 3377 3850 4334 64.68	5 100.0 200.2 300.3 400.4 509.5 599.5 799.7 999.9 1199 1496 1991 2497 2992 3498 3993 4499 67.65	355.3 473 591.8 709.5 946 1177 1419 1771 2365 2948 3542 4136 4730 5313 78.76
HDV HDH HDH	IOP 20P 30P 30P 50P 60P 80P 100P 120P 250P 200P 250P 300P 400P 400P 400P 400P 400P 20P 300P 60P 80P 100P 200P 200P 300P 300P 300P 200P 300P 200P 200P 200P 300P 300P <th>10 20 30 40 50 60 100 120 250 250 300 400 450 10 20 350 400 450 50 60 80 100 120 150 200 250 300 300 450 50 60 100 100 120 150 200 250 300 400 250 300 400 250 300 400 250 300 400 250 300 400 250 300 400 250 300 400 250 300 400 400 250 300 400 400 400 250 300 400 400 400 450 50 400 450 50 50 400 450 50 50 400 450 50 50 400 450 50 50 50 50 400 450 50 50 50 50 50 50 50 50 50</th> <th>1.122 2.244 3.366 4.488 5.61 1.22 13.42 16.83 22.44</th> <th>1.397 2.794 4.191 5.588 6.974 8.371 11.22 13.97 16.72</th> <th>2.222 4.44 6.666 8.888 11.11 13.31 17.82 22.22</th> <th>3.729 7.458 11.22 14.96 18.59 22.33</th> <th>5.203 10.37 15.62 20.79 25.96</th> <th>6.787 13.64 20.35 27.17</th> <th>11.2 22.44 33.66 44.88 56.98 67.32 112.2 134.2 134.2 134.2 1368.3 224.4 280.5 336.6 392.7 448.8 504.9 9.823 19.69 29.48</th> <th>20.8 41.47 62.26 83.05 103.7 124.3 166.1 207.9 248.6 311.3 414.7 519.2 622.6 726 830.5 933.9 17.71 35.53</th> <th>28.9 57.86 86.9 115.5 145.2 173.8 232.1 289.3 347.6 434.5 578.6 723.8 867.9 1013 1155 1298 23.43 46.86</th> <th>36.6 73.37 110 146.3 183.7 220 293.7 366.3 440 550 733.7 916.3 1100 1276 1463 1650 26.84 53.68</th> <th>47.9 95.7 143 191.4 238.7 287.1 382.8 478.5 574.2 717.2 957 1188 1430 1672 1903 2145 30.58</th> <th>61.2 122.1 183.7 244.2 305.8 366.3 488.4 611.6 733.7 916.3 1221 1518 1826 2134 2442 2750 36.63</th> <th>169.4 254.1 338.8 423.5 508.2 676.5 834.9 1015 1265 1683 2112 2530 2959 3377 3806 50.05</th> <th>91.6 183.7 275 366.3 458.7 550 733.7 916.3 1100 1375 1826 2288 2750 3201 3663 4125 55</th> <th>96.5 192.5 289.3 386.1 482.9 578.6 772.2 964.7 1155 1447 1925 2409 2893 3377 3850 4334 64.68</th> <th>100.0 200.2 300.3 400.4 500.5 599.5 799.7 999.9 1199 1496 1991 2497 2992 3498 3993 4499 67.65</th> <th>117.7 236.5 355.3 473 591.8 709.5 946 1177 1419 1771 2365 2948 3542 4136 4730 5313 78.76</th>	10 20 30 40 50 60 100 120 250 250 300 400 450 10 20 350 400 450 50 60 80 100 120 150 200 250 300 300 450 50 60 100 100 120 150 200 250 300 400 250 300 400 250 300 400 250 300 400 250 300 400 250 300 400 250 300 400 250 300 400 400 250 300 400 400 400 250 300 400 400 400 450 50 400 450 50 50 400 450 50 50 400 450 50 50 400 450 50 50 50 50 400 450 50 50 50 50 50 50 50 50 50	1.122 2.244 3.366 4.488 5.61 1.22 13.42 16.83 22.44	1.397 2.794 4.191 5.588 6.974 8.371 11.22 13.97 16.72	2.222 4.44 6.666 8.888 11.11 13.31 17.82 22.22	3.729 7.458 11.22 14.96 18.59 22.33	5.203 10.37 15.62 20.79 25.96	6.787 13.64 20.35 27.17	11.2 22.44 33.66 44.88 56.98 67.32 112.2 134.2 134.2 134.2 1368.3 224.4 280.5 336.6 392.7 448.8 504.9 9.823 19.69 29.48	20.8 41.47 62.26 83.05 103.7 124.3 166.1 207.9 248.6 311.3 414.7 519.2 622.6 726 830.5 933.9 17.71 35.53	28.9 57.86 86.9 115.5 145.2 173.8 232.1 289.3 347.6 434.5 578.6 723.8 867.9 1013 1155 1298 23.43 46.86	36.6 73.37 110 146.3 183.7 220 293.7 366.3 440 550 733.7 916.3 1100 1276 1463 1650 26.84 53.68	47.9 95.7 143 191.4 238.7 287.1 382.8 478.5 574.2 717.2 957 1188 1430 1672 1903 2145 30.58	61.2 122.1 183.7 244.2 305.8 366.3 488.4 611.6 733.7 916.3 1221 1518 1826 2134 2442 2750 36.63	169.4 254.1 338.8 423.5 508.2 676.5 834.9 1015 1265 1683 2112 2530 2959 3377 3806 50.05	91.6 183.7 275 366.3 458.7 550 733.7 916.3 1100 1375 1826 2288 2750 3201 3663 4125 55	96.5 192.5 289.3 386.1 482.9 578.6 772.2 964.7 1155 1447 1925 2409 2893 3377 3850 4334 64.68	100.0 200.2 300.3 400.4 500.5 599.5 799.7 999.9 1199 1496 1991 2497 2992 3498 3993 4499 67.65	117.7 236.5 355.3 473 591.8 709.5 946 1177 1419 1771 2365 2948 3542 4136 4730 5313 78.76
HDV HDV HDV HDV HDV HDV HDV HDV HDV HDV	30P 40P 50P 60P 80P 100P 250P 250P 250P 350P 450P 10P 20P 300P 20P 300P 20P 300P 20P 300P 20P 300P 20P 300P 20P 20P 300P 20P 20P 450P 20P 450P 20P 450P 20P 450P 20P 450P 20P 450P 20P 450P 20P 450P 20P 450P 20P 450P 20P 450P 20P 450P 20P 20P 20P 20P 20P 20P 20P 2	30 40 50 60 80 120 150 200 250 300 350 400 450 400 450 50 60 80 100 120 50 60 100 120 150 200 250 300	2.244 3.366 4.488 5.61 6.732 8.976 11.22 13.42 16.83 22.44	2.794 4.191 5.588 6.974 8.371 11.22 13.97 16.72	4.444 6.666 8.888 11.11 13.31 17.82 22.22	7.458 11.22 14.96 18.59 22.33	10.37 15.62 20.79 25.96	13.64 20.35 27.17	33.66 44.88 56.98 67.32 89.76 112.2 134.2 168.3 224.4 280.5 336.6 392.7 448.8 504.9 9.823 19.69 29.48	62.26 83.05 103.7 124.3 166.1 207.9 248.6 311.3 414.7 519.2 622.6 726 830.5 933.9 17.71 35.53	86.9 115.5 145.2 173.8 232.1 289.3 347.6 434.5 578.6 723.8 867.9 1013 1155 1298 23.43 46.86	110 146.3 183.7 220 293.7 366.3 440 550 733.7 916.3 1100 1276 1463 1650 26.84 53.68	143 191.4 238.7 287.1 382.8 478.5 574.2 717.2 957 1188 1430 1672 1903 2145 30.58	183.7 244.2 305.8 366.3 488.4 611.6 733.7 916.3 1221 1518 1826 2134 2442 2750 36.63	254.1 338.8 423.5 508.2 676.5 834.9 1015 1265 1683 2112 2530 2959 3377 3806 50.05	275 366.3 458.7 550 733.7 916.3 1100 1375 1826 2288 2750 3201 3663 4125 55	289.3 386.1 482.9 578.6 772.2 964.7 1155 1441 1925 2409 2893 3377 3850 4334 64.68	300.3 400.4 500.5 599.5 799.7 999.9 1199 1496 1991 2497 2992 3498 3993 4499 67.65	355.3 473 591.8 709.5 946 1177 1419 1771 2365 2948 3542 4136 4730 5313 78.76
HDV HDV HDV HDV HDV HDV HDV HDV HDV HDV	40P 50P 60P 100P 120P 120P 250P 250P 250P 400P 50P 60P 120P 300P 450P 100P 200P 300P 120P 120P 300P 300P 300P 300P 450P	40 50 60 100 120 250 250 350 400 450 10 20 350 400 450 50 60 80 120 150 220 300 300 300 300 300 300 30	2.244 3.366 4.488 5.61 6.732 8.976 11.22 13.42 16.83 22.44	2.794 4.191 5.588 6.974 8.371 11.22 13.97 16.72	4.444 6.666 8.888 11.11 13.31 17.82 22.22	7.458 11.22 14.96 18.59 22.33	10.37 15.62 20.79 25.96	13.64 20.35 27.17	44.88 56.98 67.32 89.76 112.2 134.2 168.3 224.4 280.5 336.6 392.7 448.8 504.9 9.823 19.69 29.48	83.05 103.7 124.3 166.1 207.9 248.6 311.3 414.7 519.2 622.6 726 830.5 933.9 17.71 35.53	115.5 145.2 173.8 232.1 289.3 347.6 434.5 578.6 723.8 867.9 1013 1155 1298 23.43 46.86	146.3 183.7 220 293.7 366.3 440 550 733.7 916.3 1100 1276 1463 1650 26.84 53.68	191.4 238.7 287.1 382.8 478.5 574.2 717.2 957 1188 1430 1672 1903 2145 30.58	244.2 305.8 366.3 488.4 611.6 733.7 916.3 1221 1518 1826 2134 2442 2750 36.63	338.8 423.5 508.2 676.5 834.9 1015 1265 1683 2112 2530 2959 3377 3806 50.05	366.3 458.7 550 733.7 916.3 1100 1375 1826 2288 2750 3201 3663 4125 55	386.1 482.9 578.6 772.2 964.7 1155 1441 1925 2409 2893 3377 3850 4334 64.68	400.4 500.5 599.5 799.7 999.9 1199 1496 1991 2497 2992 3498 3993 4499 67.65	473 591.8 709.5 946 1177 1419 1771 2365 2948 3542 4136 4730 5313 78.76
HDV HDV HDV HDV HDV HDV HDV HDV HDV HDV	50P 60P 80P 120P 220P 250P 250P 300P 350P 400P 450P 50P 60P 10P 20P 50P 60P 100P 120P 120P 250P 300P 250P 250P 250P 450P	50 60 80 120 250 300 450 450 450 450 450 450 450 50 60 80 100 80 120 30 30 30 30 30 30 30 30 30 30 30 30 30	2.244 3.366 4.488 5.61 6.732 8.976 11.22 13.42 16.83 22.44	2.794 4.191 5.588 6.974 8.371 11.22 13.97 16.72	4.444 6.666 8.888 11.11 13.31 17.82 22.22	7.458 11.22 14.96 18.59 22.33	10.37 15.62 20.79 25.96	13.64 20.35 27.17	56.98 67.32 89.76 112.2 134.2 168.3 224.4 280.5 336.6 392.7 448.8 504.9 9.823 19.69 29.48	103.7 124.3 166.1 207.9 248.6 311.3 414.7 519.2 622.6 726 830.5 933.9 17.71 35.53	145.2 173.8 232.1 289.3 347.6 434.5 578.6 723.8 867.9 1013 1155 1298 23.43 46.86	183.7 220 293.7 366.3 440 550 733.7 916.3 1100 1276 1463 1650 26.84 53.68	238.7 287.1 382.8 478.5 574.2 957 1188 1430 1672 1903 2145 30.58	305.8 366.3 488.4 611.6 733.7 916.3 1221 1518 1826 2134 2442 2750 36.63	423.5 508.2 676.5 834.9 1015 1265 1683 2112 2530 2959 3377 3806 50.05	458.7 550 733.7 916.3 1100 1375 1826 2288 2750 3201 3663 4125 55	482.9 578.6 772.2 964.7 1155 1441 1925 2409 2893 3377 3850 4334 64.68	500.5 599.5 799.7 999.9 1199 1496 1991 2497 2992 3498 3993 4499 67.65	591.8 709.5 946 1177 1419 1771 2365 2948 3542 4136 4730 5313 78.76
HDV HDH HDH	60P 80P 100P 120P 250P 250P 250P 250P 400P 400P 300P 300P 300P 50P 120P 150P 250P 120P 150P 250P 300P 4450P	60 80 100 150 250 350 400 450 450 50 60 80 10 20 30 10 20 30 40 50 60 80 100 120 150 200 300	2.244 3.366 4.488 5.61 6.732 8.976 11.22 13.42 16.83 22.44	2.794 4.191 5.588 6.974 8.371 11.22 13.97 16.72	4.444 6.666 8.888 11.11 13.31 17.82 22.22	7.458 11.22 14.96 18.59 22.33	10.37 15.62 20.79 25.96	13.64 20.35 27.17	67.32 89.76 112.2 134.2 168.3 224.4 280.5 336.6 392.7 448.8 504.9 9.823 19.69 29.48	124.3 166.1 207.9 248.6 311.3 414.7 519.2 622.6 726 830.5 933.9 17.71 35.53	173.8 232.1 289.3 347.6 434.5 578.6 723.8 867.9 1013 1155 1298 23.43 46.86	220 293.7 366.3 440 550 733.7 916.3 1100 1276 1463 1650 26.84 53.68	287.1 382.8 478.5 574.2 957 1188 1430 1672 1903 2145 30.58	366.3 488.4 611.6 733.7 916.3 1221 1518 1826 2134 2442 2750 36.63	508.2 676.5 834.9 1015 1265 1683 2112 2530 2959 3377 3806 50.05	550 733.7 916.3 1100 1375 1826 2288 2750 3201 3663 4125 55	578.6 772.2 964.7 1155 1441 1925 2409 2893 3377 3850 4334 64.68	599.5 799.7 999.9 1199 1496 1991 2497 2992 3498 3993 4499 67.65	709.5 946 1177 1419 1771 2365 2948 3542 4136 4730 5313 78.76
HDV HDV HDV HDV HDV HDV HDV HDV HDV HDV	100P 120P 200P 250P 350P 350P 450P 20P 30P 450P 50P 60P 100P 120P 200P 250P 300P 250P 350P 400P	100 120 150 200 250 350 400 450 10 20 30 400 450 50 60 80 100 120 150 220 150 250 300	2.244 3.366 4.488 5.61 6.732 8.976 11.22 13.42 16.83 22.44	2.794 4.191 5.588 6.974 8.371 11.22 13.97 16.72	4.444 6.666 8.888 11.11 13.31 17.82 22.22	7.458 11.22 14.96 18.59 22.33	10.37 15.62 20.79 25.96	13.64 20.35 27.17	112.2 134.2 168.3 224.4 280.5 336.6 392.7 448.8 504.9 9.823 19.69 29.48	207.9 248.6 311.3 414.7 519.2 622.6 726 830.5 933.9 17.71 35.53	289.3 347.6 434.5 578.6 723.8 867.9 1013 1155 1298 23.43 46.86	366.3 440 550 733.7 916.3 1100 1276 1463 1650 26.84 53.68	478.5 574.2 957 1188 1430 1672 1903 2145 30.58	611.6 733.7 916.3 1221 1518 1826 2134 2442 2750 36.63	834.9 1015 1265 1683 2112 2530 2959 3377 3806 50.05	916.3 1100 1375 1826 2288 2750 3201 3663 4125 55	964.7 1155 1441 1925 2409 2893 3377 3850 4334 64.68	999.9 1199 1496 1991 2497 2992 3498 3993 4499 67.65	1177 1419 1771 2365 2948 3542 4136 4730 5313 78.76
HDV HDH HDH	120P 150P 200P 250P 350P 400P 10P 20P 30P 40P 50P 20P 20P 20P 20P 200P 250P 250P 25	120 150 250 300 350 450 10 20 30 40 50 60 80 100 120 150 200 300	2.244 3.366 4.488 5.61 6.732 8.976 11.22 13.42 16.83 22.44	2.794 4.191 5.588 6.974 8.371 11.22 13.97 16.72	4.444 6.666 8.888 11.11 13.31 17.82 22.22	7.458 11.22 14.96 18.59 22.33	10.37 15.62 20.79 25.96	13.64 20.35 27.17	134.2 168.3 224.4 280.5 336.6 392.7 448.8 504.9 9.823 19.69 29.48	248.6 311.3 414.7 519.2 622.6 726 830.5 933.9 17.71 35.53	347.6 434.5 578.6 723.8 867.9 1013 1155 1298 23.43 46.86	440 550 733.7 916.3 1100 1276 1463 1650 26.84 53.68	574.2 957 1188 1430 1672 1903 2145 30.58	733.7 916.3 1221 1518 1826 2134 2442 2750 36.63	1015 1265 1683 2112 2530 2959 3377 3806 50.05	1100 1375 1826 2288 2750 3201 3663 4125 55	1155 1441 1925 2409 2893 3377 3850 4334 64.68	1199 1496 1991 2497 2992 3498 3993 4499 67.65	1419 1771 2365 2948 3542 4136 4730 5313 78.76
HDV HDH HDH	150P 200P 250P 300P 350P 450P 10P 20P 30P 50P 60P 50P 60P 120P 120P 120P 200P 250P 300P 150P 250P 350P 450P	150 200 250 300 350 400 450 10 20 30 40 50 60 80 80 100 120 150 200 300 300 300 300 300 300 350 400 450 450 450 450 450 450 4	2.244 3.366 4.488 5.61 6.732 8.976 11.22 13.42 16.83 22.44	2.794 4.191 5.588 6.974 8.371 11.22 13.97 16.72	4.444 6.666 8.888 11.11 13.31 17.82 22.22	7.458 11.22 14.96 18.59 22.33	10.37 15.62 20.79 25.96	13.64 20.35 27.17	168.3 224.4 280.5 336.6 392.7 448.8 504.9 9.823 19.69 29.48	311.3 414.7 519.2 622.6 726 830.5 933.9 17.71 35.53	434.5 578.6 723.8 867.9 1013 1155 1298 23.43 46.86	550 733.7 916.3 1100 1276 1463 1650 26.84 53.68	717.2 957 1188 1430 1672 1903 2145 30.58	916.3 1221 1518 1826 2134 2442 2750 36.63	1265 1683 2112 2530 2959 3377 3806 50.05	1375 1826 2288 2750 3201 3663 4125 55	1441 1925 2409 2893 3377 3850 4334 64.68	1496 1991 2497 2992 3498 3993 4499 67.65	1771 2365 2948 3542 4136 4730 5313 78.76
HDV HDV HDV HDV HDV HDV HDV HDV HDH HDH	200P 250P 300P 350P 400P 450P 20P 30P 40P 50P 50P 120P 250P 250P 250P 250P 250P 400P	200 250 350 400 450 20 30 400 450 50 60 80 100 120 150 200 300	2.244 3.366 4.488 5.61 6.732 8.976 11.22 13.42 16.83 22.44	2.794 4.191 5.588 6.974 8.371 11.22 13.97 16.72	4.444 6.666 8.888 11.11 13.31 17.82 22.22	7.458 11.22 14.96 18.59 22.33	10.37 15.62 20.79 25.96	13.64 20.35 27.17	224.4 280.5 336.6 392.7 448.8 504.9 9.823 19.69 29.48	414.7 519.2 622.6 726 830.5 933.9 17.71 35.53	578.6 723.8 867.9 1013 1155 1298 23.43 46.86	733.7 916.3 1100 1276 1463 1650 26.84 53.68	957 1188 1430 1672 1903 2145 30.58	1221 1518 1826 2134 2442 2750 36.63	1683 2112 2530 2959 3377 3806 50.05	1826 2288 2750 3201 3663 4125 55	1925 2409 2893 3377 3850 4334 64.68	1991 2497 2992 3498 3993 4499 67.65	2365 2948 3542 4136 4730 5313 78.76
HDV HDV HDV HDV HDV HDV HDV HDH	300P 350P 400P 450P 20P 30P 50P 60P 50P 60P 100P 120P 120P 150P 250P 300P 350P 400P 450P	300 350 400 450 10 20 30 40 50 60 80 100 120 150 200 250 300	2.244 3.366 4.488 5.61 6.732 8.976 11.22 13.42 16.83 22.44	2.794 4.191 5.588 6.974 8.371 11.22 13.97 16.72	4.444 6.666 8.888 11.11 13.31 17.82 22.22	7.458 11.22 14.96 18.59 22.33	10.37 15.62 20.79 25.96	13.64 20.35 27.17	336.6 392.7 448.8 504.9 9.823 19.69 29.48	622.6 726 830.5 933.9 17.71 35.53	867.9 1013 1155 1298 23.43 46.86	1100 1276 1463 1650 26.84 53.68	1430 1672 1903 2145 30.58	1826 2134 2442 2750 36.63	2530 2959 3377 3806 50.05	2750 3201 3663 4125 55	2893 3377 3850 4334 64.68	2992 3498 3993 4499 67.65	3542 4136 4730 5313 78.76
HDV HDV HDV HDH HDH HDH HDH HDH HDH HDH	350P 400P 450P 30P 30P 50P 60P 80P 100P 120P 150P 250P 300P 350P 400P 450P	350 400 450 20 20 30 40 50 60 80 100 120 150 200 250 300	2.244 3.366 4.488 5.61 6.732 8.976 11.22 13.42 16.83 22.44	2.794 4.191 5.588 6.974 8.371 11.22 13.97 16.72	4.444 6.666 8.888 11.11 13.31 17.82 22.22	7.458 11.22 14.96 18.59 22.33	10.37 15.62 20.79 25.96	13.64 20.35 27.17	392.7 448.8 504.9 9.823 19.69 29.48	726 830.5 933.9 17.71 35.53	1013 1155 1298 23.43 46.86	1276 1463 1650 26.84 53.68	1672 1903 2145 30.58	2134 2442 2750 36.63	2959 3377 3806 50.05	3201 3663 4125 55	3377 3850 4334 64.68	3498 3993 4499 67.65	4136 4730 5313 78.76
HDV HDV HDH HDH HDH HDH HDH HDH HDH HDH	400P 450P 20P 30P 40P 50P 60P 80P 100P 120P 120P 250P 300P 350P 400P 450P	400 450 10 20 30 40 50 60 80 100 120 150 200 250 300	2.244 3.366 4.488 5.61 6.732 8.976 11.22 13.42 16.83 22.44	2.794 4.191 5.588 6.974 8.371 11.22 13.97 16.72	4.444 6.666 8.888 11.11 13.31 17.82 22.22	7.458 11.22 14.96 18.59 22.33	10.37 15.62 20.79 25.96	13.64 20.35 27.17	448.8 504.9 9.823 19.69 29.48	830.5 933.9 17.71 35.53	1155 1298 23.43 46.86	1463 1650 26.84 53.68	1903 2145 30.58	2442 2750 36.63	3377 3806 50.05	3663 4125 55	3850 4334 64.68	3993 4499 67.65	4730 5313 78.76
HDV HDH HDH HDH HDH HDH HDH HDH HDH HDH	450P 10P 20P 30P 50P 60P 80P 100P 120P 120P 120P 250P 300P 350P 400P 450P	450 10 20 30 50 60 80 100 120 150 200 250 300	2.244 3.366 4.488 5.61 6.732 8.976 11.22 13.42 16.83 22.44	2.794 4.191 5.588 6.974 8.371 11.22 13.97 16.72	4.444 6.666 8.888 11.11 13.31 17.82 22.22	7.458 11.22 14.96 18.59 22.33	10.37 15.62 20.79 25.96	13.64 20.35 27.17	504.9 9.823 19.69 29.48	933.9 17.71 35.53	1298 23.43 46.86	1650 26.84 53.68	2145 30.58	2750 36.63	3806 50.05	4125 55	4334 64.68	4499 67.65	5313 78.76
HDH HDH HDH HDH HDH HDH HDH HDH HDH HDH	10P 20P 30P 50P 60P 80P 100P 120P 120P 150P 250P 300P 350P 400P 450P	10 20 30 40 50 60 80 100 120 150 200 250 300	2.244 3.366 4.488 5.61 6.732 8.976 11.22 13.42 16.83 22.44	2.794 4.191 5.588 6.974 8.371 11.22 13.97 16.72	4.444 6.666 8.888 11.11 13.31 17.82 22.22	7.458 11.22 14.96 18.59 22.33	10.37 15.62 20.79 25.96	13.64 20.35 27.17	19.69 29.48	35.53	46.86	53.68							
HDH HDH HDH HDH HDH HDH HDH HDH HDH HDH	30P 40P 50P 60P 100P 120P 120P 250P 300P 350P 400P 450P	30 40 50 60 100 120 150 200 250 300	3.366 4.488 5.61 6.732 8.976 11.22 13.42 16.83 22.44	4.191 5.588 6.974 8.371 11.22 13.97 16.72	6.666 8.888 11.11 13.31 17.82 22.22	11.22 14.96 18.59 22.33	15.62 20.79 25.96	20.35 27.17	29.48				61.16	73 37	99 99	110	120 0		4 5 7 5
HDH HDH HDH HDH HDH HDH HDH HDH HDH HDH	40P 50P 60P 100P 120P 150P 250P 350P 400P 450P	40 50 60 100 120 150 200 250 300	4.488 5.61 6.732 8.976 11.22 13.42 16.83 22.44	5.588 6.974 8.371 11.22 13.97 16.72	8.888 11.11 13.31 17.82 22.22	14.96 18.59 22.33	20.79 25.96	27.17		53.13						110			
HDH HDH HDH HDH HDH HDH HDH HDH HDH HDH	50P 60P 80P 100P 120P 150P 200P 250P 350P 400P 450P	50 60 80 100 120 150 200 250 300	5.61 6.732 8.976 11.22 13.42 16.83 22.44	6.974 8.371 11.22 13.97 16.72	11.11 13.31 17.82 22.22	18.59 22.33	25.96				93.61			110	149.6	165 220	193.6 258.5	206.8	235.4
HDH HDH HDH HDH HDH HDH HDH HDH HDH HDH	60P 80P 100P 120P 150P 200P 250P 300P 350P 400P 450P	60 80 100 120 150 200 250 300	6.732 8.976 11.22 13.42 16.83 22.44	8.371 11.22 13.97 16.72	13.31 17.82 22.22	22.33				I	116.6			183.7	249.7	275		344.3	
HDH HDH HDH HDH HDH HDH HDH HDH HDH HDH	100P 120P 200P 250P 300P 350P 400P 450P	100 120 150 200 250 300	11.22 13.42 16.83 22.44	13.97 16.72	22.22	20.01	01.10	40.7	58.96	I		160.6	183.7	220	300.3	330	388.3	412.5	471.9
HDH HDH HDH HDH HDH HDH HDH HDH	120P 150P 200P 250P 300P 350P 400P 450P	120 150 200 250 300	13.42 16.83 22.44	16.72		29.81	41.47	543.4	78.54	1	187	214.5	244.2	293.7	400.4	440	518.1	550	628.1
HDH HDH HDH HDH HDH HDH HDH	150P 200P 250P 300P 350P 400P 450P	150 200 250 300	16.83 22.44		26.62						234.3 280.5			366.3 440	500.5 599.5	550 660	646.8 776.6	687.5 825	785.4
HDH HDH HDH HDH HDH HDH	200P 250P 300P 350P 400P 450P	200 250 300	22.44	20.0		55.88		101.9				402.6	458.7	550	750.2	825	970.2	1032	1177
HDH HDH HDH HDH HDH	300P 350P 400P 450P	300	28.05	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 HDH HDH HDH	350P 400P 450P				55.55							671		886.6	1100	1188	1309	1430	1595
HDH HDH HDH	400P 450P	300		41.91	66.66 77.77	112.2				1	701.8		916.3 1069	1065 1232	1320 1540	1430	1562 1826	1650 1925	1826 2134
HDH HDH	450P	400			88.88						936.1	1074	1221	1419	1760	1903	2090	2200	2442
		450		62.81	99.99			305.8				1199	1375	1595	1980	2145	2354	2475	2750
HDH	500P	500	56.1		111.1							1331	1518	1771	2200	2387	2618	2750	3047
	600P	600			133.1			407	589.6 687.5	1065	1397	1606 1870	1826 2134	2123 2475	2640 3080	2860 3344	3135 3663	3300 3850	3663 4268
HDH	700P 10P	700 10	1.12	97.68	2.21	260.7 3.66	363	475.2 6.79	9.0	13.2	1628	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		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 HDM	50P 60P	50 60		6.941 8.338		18.37	26.73 32.01	40.7	45.1 54.12	66.2 79.5	76.34	83.38 99.99	110	119.9	119.9 143	130.9	137.5 165	152.9 183.7	
HDM	80P	80		11.11	17.71			54.34			122.1			159.5	191.4	209	220		325.6
	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
	120P	120		16.72		44		81.51		<u> </u>	183.7		286	239.8	287.1	314.6	330		488.4
	150P 200P	150 200	16.72	20.79	33.22 44.22	55 73 37	80.08 106.8	101.9	135.3		228.8 305.8		275 366 3	300.3	358.6	392.7 523.6	412.5 550	458.7 611.6	611.6
	250P	250	27.94		55.33						381.7			500.5	597.3	654.5		763.4	
	300P	300		41.69		110		203.5			458.7		550	599.5	717.2	785.4	825	916.3	1221
	350P	350			77.44		187		315.7		534.6	583	641.3		837.1	916.3		1069	1419
	400P	400			88.44	146.3	213.4 239.8	271.7 305.8			611.6 687.5		733.7 825	799.7	957 85.8	1047	1100	1221 1375	1628 1826
	450P 500P	450 500	50.27	69.41			267.3		405.5		763.4				1188	1309	1375	1518	2035
	600P	600		83.38		220	320.1	407	541.2		916.3		1100	1199	1430	1562	1650	1826	2442
	700P	700	78.21		155.1	256.3	374	475.2				1166	1276	1397	1672	1826	1925	2134	2849
	800P	800 900		111.1 125.4	177.1			543.4 611.6			1221 1375	1331 1496	1463 1650	1595 1793	1903 2145	2090	2200 2475	2442 2750	3256 3663
	900P 1000P	1000			221.1											2618			
HDS	10P	10		1.386	2.2					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			11.22		1						38.61			
HDS	30P	30		4.147	6.6			16.72								57.86			
HDS HDS	40P 50P	40 50		5.533 6.908	8.8 11			22.33								77.22 96.58			
HDS	60P	60		8.294												115.5			
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		
	100P	100		13.86	22			55.88								192.5			
	120P 150P	120		16.61 20.68	26.4											232.1 289.3			
	200P	200		27.61	44											386.1			
	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		
	300P	300		41.47	66					1	297								
	350P	350	38.94		77			195.8		1	346.5						583 666 6		
	400P 450P	400 450		55.33 62.15	88			223.3								628.1 707.3			
	500P	500		69.08	110			279.4								785.4			
	600P	600		82.94	132	206.8	280.5	335.5	412.5	541.2						942.7			
	700P	700		96.69	154						694.1								
	800P	800		111.1	176	275					793.1								
	900P 1000P	900 1000		124.3 138.6	198 220						892.1 991.1								

Table 8-5, Discharge End Voltage 1.0Vpc

8.1 Discharge Voltage, continued

Specifications provided courtesy of Alpha Industrial Power (AIP) and have not been verified by Alpha Technologies.

Very High-Rate Type HDV-P

Very High-Rate Type HDH-P

Ce	11		Minutes	;		:	Second	S	
Тур	e	2	1.5	1	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

C	ell		Minutes	;			Second	s	
T	ype	2	1.5	1	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	49 6	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	1 48 7	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	3365	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

C	ell	[Minutes	;			Second	s	
T	/pe	2	1.5	1	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	958 3	10350

Very High-Rate Type HDH-P

С	ell		Minutes	;			Second	s	
Ty	/pe	2	1.5	1	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
HƠH	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



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 (0) 1279-501110 Fax: +44 (0) 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

Alpha Technologies 5 Avenue Victor Hugo F-92140 Calmart France FRANCE Tel: +33-3-41-90-07-07 Fax: +33-1-41-90-93-12