

**HI-4416**  
**System Readout**  
**User Manual**

**Declaration of Conformity**

ETS-Lindgren, L.P.  
1301 Arrow Point Drive  
Cedar Park, TX 78613  
USA



Declares that the HOLADAY product described in this instruction manual is in compliance with: EN EMC Directive 86/336/EEC, EN50082-1, EN55011

**ETS-Lindgren, L.P.**  
**(Formerly Holaday Industries, Inc.)**



## HI-4416 System Readout

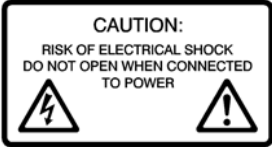



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### Revision Record--HI-4416, Manual, Part #H-600050

Revision	Description	Date
	Initial Release	July, 1993
A	Software Updates	March, 1995
B	Update	January, 1996
C	Changed Battery Charger	June, 1997
D	Added CD Label	June, 1997
E	Changed Charger Specs	August, 1999
F	Changed Area Code	February, 2000
G	Updated contact info. and added charger manual as addendum.	February, 2006

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<b>General Safety Considerations</b>	
	<p>This symbol warns the user that un-insulated voltage within the unit may have sufficient magnitude to cause electric shock. Therefore, it is dangerous to make any kind of contact with any parts inside this unit.</p>
	<p>This symbol alerts the user that important literature concerning the operation and maintenance of this unit has been included. Therefore, it should be read carefully in order to avoid any problems.</p>
	<p><b>Warning:</b> This is a Safety Class I product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor, inside or outside the instrument, is likely to make the instrument dangerous. Intentional interruption is prohibited. DO NOT defeat the earth-grounding protection by using an extension cable, power cable, or autotransformer without a protective ground conductor.</p>
	<p><b>Caution:</b> This instrument is shipped with a three-wire power cable, in accordance with international safety standards. When connected to an appropriate power line outlet, this cable grounds the instrument cabinet.</p>

<b>General Safety Considerations</b>	
<b>WARNING</b>	<b>Warning:</b> No operator serviceable parts exist inside. Refer servicing to qualified personnel. To prevent electrical shock, do not remove covers.
<b>WARNING</b>	<b>Warning:</b> This instrument is used in a manner not specified by ETS-Lindgren; the protection provided by the instrument may be impaired.
<b>WARNING</b>	<b>Warning:</b> Do not position the equipment so that it is difficult to connect or disconnect cables into the back of the unit.

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HI-4416 System Readout

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## 1. Introduction

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The HI-4000 Hazard Measurement System introduces fiber optic technology for the acquisition of data from electric and magnetic fields. The use of fiber optic cables for data transfer minimizes perturbation during field measurements.

The heart of this system is the HI-4416 System Readout. This fiber optically isolated remote readout/control can be paired with any one of the ETS-Lindgren lines of electric and magnetic field probes to provide a wide range (10 kHz to 40 GHz) of field measurements.

Standard features of the HI-4416 System Readout include data logging, a recorder output, and a custom Liquid Crystal Display (LCD) with bar graph. The data log feature captures up to 150 field readings for later review. The recorder output provides a DC voltage proportional to the indicated field value. All selection and control functions are input via the front panel keypad's membrane switches; this keypad is configured in a matrix, allowing access to twelve functions.

The HI-4416 uses an ASCII character string for communication with the probe in both directions. Addendum B details the data format.

The HI-4416 System Readout may be used in conjunction with many ETS-Lindgren probes. For a current list please call ETS-Lindgren Customer Service at +512-531-6400.

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## **2. Getting Started**

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### **2.1. Unpacking and Acceptance**

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**Step 1.** Upon delivery of your order, inspect the shipping container(s) for evidence of damage. Record any damage on the delivery receipt before signing it. In case of concealed damage or loss, retain the packing materials for inspection by the carrier.

**Step 2.** Remove the readout from its shipping containers. Save the boxes and any protective packing materials for future use.

**Step 3.** Check all materials against the packing list to verify that the equipment you received matches what was ordered. If you find any discrepancies, note them and call the ETS-Lindgren Custom Service department for further instructions.

### **2.2. Bench Test**

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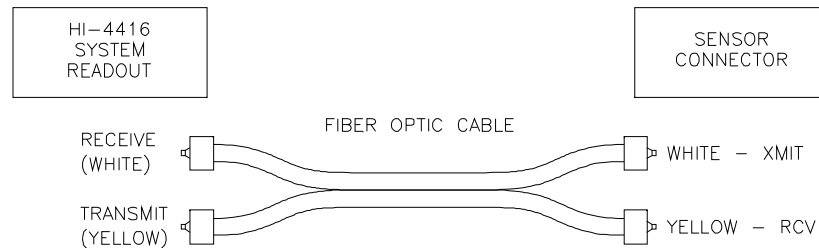
Perform the following procedures to verify system operation.

#### **2.2.1. Readout and Probe Bench Test**

**Step 1.** Remove the plastic caps from the readout's fiber optic connectors. Remove the protective covers from the fiber optic cable assembly. Save all protective caps and covers for future use.

**Step 2.** Visually inspect the tips of the fiber optic cables to ensure that they are free of dirt and other contaminants. Connect the fiber optic cable (Figure 1) to the two connectors on the top of the readout; be sure to match the cable connector colors to those on the readout connectors (yellow to TRANSMIT; white to RECEIVE).

**Step 3.** Connect the other end of the fiber optic cable to the probe connectors. Be sure to match the cable connector colors to those on the probe connectors (white to XMIT; yellow to RCV).



**Figure 1: Fiber Optic Cable Connections**

**Step 4.** Set the **ARM/OFF** switch on the probe to **ARM**.

**Step 5.** Press the **ON/OFF** keypad on the front panel of the HI-4416. All segments of the LCD will activate for two seconds, then the version of software installed in the HI-4416 will be displayed followed by the current range of the probe connected to the readout. The HI-4416 will then begin normal operation. Units of measure, current reading (if any), bar graph, etc., will be displayed. If, after several seconds, the readout indicates an error condition, see Addendum A for further information.

### 3. Specifications

<b>Operational</b>	
Battery	3.6 VDC, 1400 mA-h NiCd
Battery Charger	115/230 VAC, approximately 1 hour
Battery Charger Jack	2.5 mm Phone Jack
Fiber Optic Connectors	Standard FSMA
Recorder Out Level	0 - 5 VDC, 1 mA maximum (all ranges)
Recorder Out Jack	3.5 mm Phone Jack
Operating Life (battery fully charged)	70 hours (idle)
	80 hours (communicating)
Standard Fiber Optic Cable	200 $\mu$ m, graded index, multimode
<b>Environmental</b>	
Operating Temperature	+10 °C to +40 °C (+50 °F to +104 °F)
Humidity	5% to 95% relative humidity, non-condensing
<b>Physical</b>	
Instrument Dimensions (including connectors)	154 x 87 x 32 mm (6.07 x 3.43 x 1.25 in)
Weight:	0.42 kg (14.8 oz)

**Table 1: Specifications**

### 3.1. STANDARD FEATURES

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- Rugged Aluminum Housing
- Custom LCD Readout
- Front Panel Keypad Matrix
- Recorder Output (0 - 5 VDC)
- Nickel-Cadmium (NiCd) Battery
- Standard Quick Charger (115/230 V)

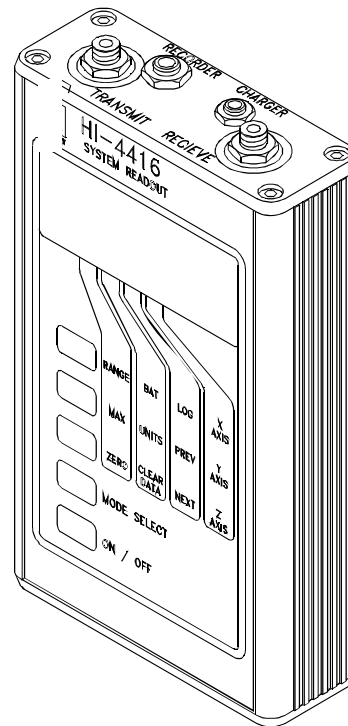


Figure 2: ETS-Lindgren's HI-4416 System Readout

## 4. Operation

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**NOTE:** The operation of the HI-4416 System Readout is controlled by membrane switches. To activate a switch, press gently on the center of the pad with your fingertip. Do not use hard or pointed objects to actuate the keypads: any resulting damage may void your warranty.

Connect a probe to the HI-4416. Make sure the switch on the probe is in the **ARM** position and then turn the System Readout **ON**. All segments of the LCD will activate for two seconds, the version of software installed will appear, followed by the current range of the probe connected to the readout. The HI-4416 then switches to normal operation (measurement). The custom LCD readout displays the observed value and the units of measure.

The bar graph along the top of the LCD window (Figure 3) presents an analog approximation of the measured field. Each bar graph segment represents five percent of the full-scale reading in the current range. The bar graph is updated 7.6 times per second while the digital display is updated 1.9 times per second.

When the measured field strength is below 5% of full scale for the range being used, the "Under Range" indicator (Figure 3) at the left end of the bar graph appears and the display will flash on and off. When possible, switch the range to permit a field strength reading that does not trigger the "Under Range" indicator. If the field strength exceeds full scale, the "Over Range" indicator (Figure 3) at the right end of the bar graph will appear and the characters "OL" will appear on the display. Select the next appropriate range.

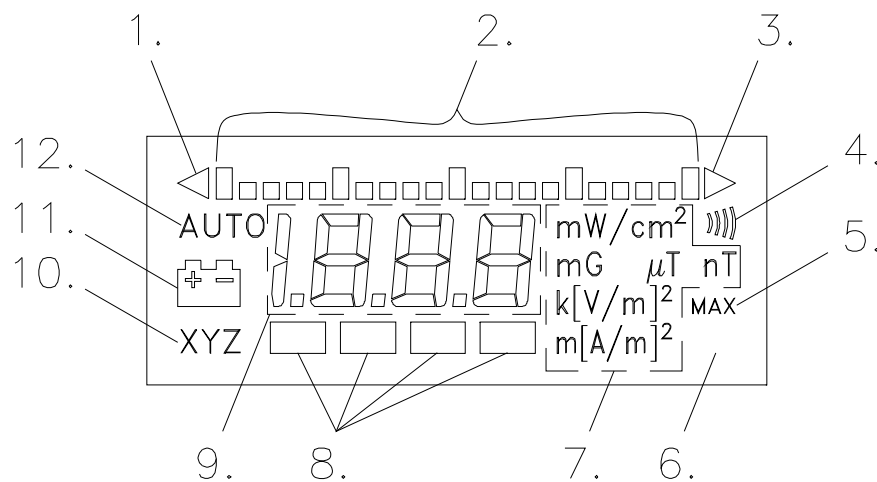
### 4.1. Display

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The HI-4416 uses a custom LCD (Figure 3) to display the probe settings and field values being measured.

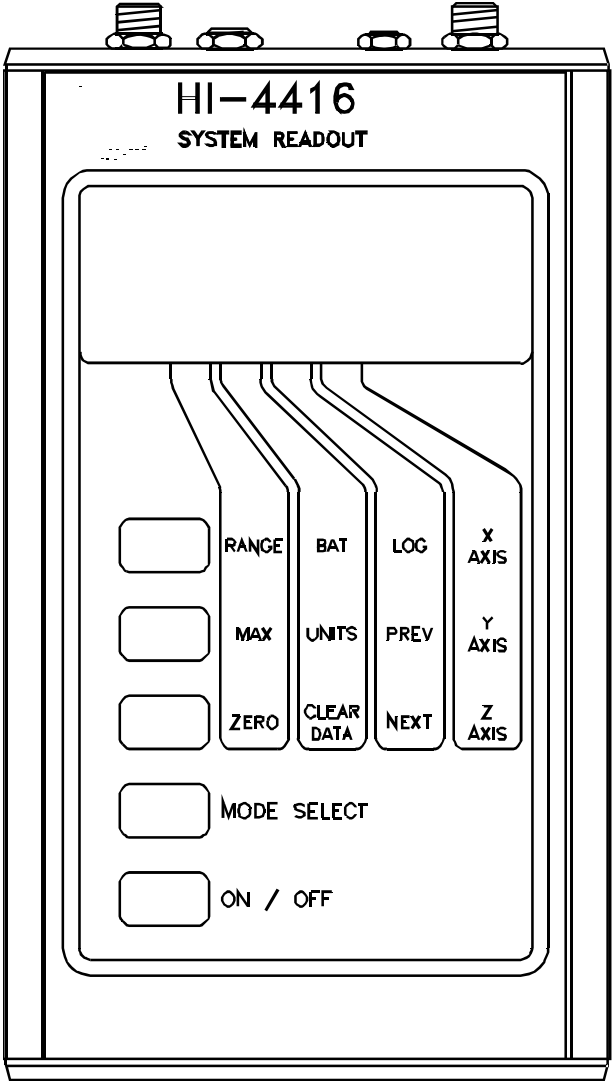
- |                                |                           |
|--------------------------------|---------------------------|
| 1. Under Range Indicator       | 2. Bar Graph              |
| 3. Over Range Indicator        | 4. Alarm Active Indicator |
| 5. Maximum Reading Indicator   | 6. Power On Indicator     |
| 7. Units of Measure Indicators | 8. Cursor Block           |
| 9. Digital Display             | 10. Axis Indicator        |
| 11. Battery Indicator          | 12. Autorange Indicator   |

**Table 2: LCD Figure Details**



**Figure 3: LCD Readout Details**

**4.2. KEYPAD OPERATION**



**Figure 4: HI-4416 Front Panel**

ON/OFF	Hardware power switch.
MODE SELECT	Selects one of the four modes of the keypad matrix.
RANGE	Displays the measurement range currently in use; changes the range.
MAX	Displays the maximum reading.
ZERO	Sends a zero command to the probe.
BAT	Displays probe battery voltage.
UNITS	Commands the probe to change units of measure and displays the new units.
CLEAR DATA	Clears all logged readings.
LOG	Saves the currently-displayed reading in EEPROM.
PREV	Displays a reading from logged data and decrements pointer to logged data.
NEXT	Displays a reading from logged data and increments pointer to logged data.
X AXIS	Commands the probe to enable/disable the X axis.
Y AXIS	Commands the probe to enable/disable the Y axis.
Z AXIS	Commands the probe to enable/disable the Z axis.

**Table 3: Keypad Operations**

#### 4.2.1. ON/OFF

Pressing the ON/OFF keypad activates the readout. At power-up, a self-test procedure is automatically performed; as part of this procedure, all segments of the LCD will activate for two seconds, then the version of software installed in the HI-4416 will appear, followed by the current range of the probe connected to the readout. After this, the System Readout switches to normal (measurement) operation. The HI-4416 does not require any warm-up or settling time prior to use.

Pressing ON/OFF again turns the readout off. Since the HI-4416 does not shut down automatically, be sure to turn the instrument off when not in use.

#### 4.2.2. MODE SELECT - Keypad Matrix

For maximum operating flexibility, the HI-4416 utilizes a matrix for the upper three keypads on the membrane switch panel. The function that each key controls depends on the location of the CURSOR block (the dark rectangle located at the bottom edge of the LCD). When the HI-4416 is turned on, the cursor automatically positions itself above the left most of the four function columns on the control panel. In this mode, the functions assigned to the three top keypads are:

- A. RANGE
- B. MAX
- C. ZERO

Pressing the MODE SELECT keypad moves the cursor block to the right, allowing access to the three functions in that column. Each successive activation of the pad moves the cursor another position to the right; from the fourth, or right most, position, the cursor returns to the first position. This configuration allows a total of twelve different functions to be assigned to the upper three keypads. These twelve functions are described below.

**RANGE**

Displays/changes the measurement range being used. When this keypad is momentarily pressed, the HI-4416 commands the probe to transmit the range currently in use; it displays this range for two seconds before returning to the measurement mode. Pressing this keypad again (while the current range is still being displayed) signals the probe to switch to the next range; the readout displays the new range. Continuing in this manner will step through all available ranges. When the highest range is reached, pressing the keypad again returns you to the lowest (most sensitive) range.

The LCD presents the range in the form r X, where X is a number. Since all probes do not contain the same number of ranges, the maximum value of X depends upon which probe is connected to the System Readout. Consult the probe literature to determine the ranges available for a particular probe.

**MAX**

Displays the maximum reading. During field measurements, the processor continually monitors and stores the highest measured field value. To recall and display this value, press the MAX keypad. The maximum reading, denoted by the MAX indicator near the right edge of the LCD, appears on the display. This reading remains as long as the MAX keypad is pressed. When the MAX keypad is released, the LCD retains the reading for approximately two seconds, after which the MAX memory location is cleared and a new maximum reading is accumulated.

**NOTE:** If the maximum reading is over full scale for the range, 'OL' will appear on the display along with the over range indicator.

The maximum value is cleared when the HI-4416 is powered up, when the MAX key is released (see above) and when the unit of measure is changed. The CLEAR button does not affect this reading.

**ZERO**

Transmits a zero command to the probe. Invoking this command zeroes all ranges and axes. This mode establishes a baseline for measurements by sampling all axes and ranges and subtracting those values from each subsequent measurement.

**BAT**

Displays probe battery voltage and temperature (if the probe is capable of communicating battery status; refer to the manual for your probe). Pressing this key with the probe connected and ARMED causes the LCD to display 1) a small battery symbol on the left side of the readout and 2) the battery voltage of the probe. After two seconds, the readout will also display probe temperature in °F. After another two seconds, the readout returns to the measurement mode. Compare the voltage reading you obtain with that stated in the probe manual.

When the probe's battery voltage decreases below a preset limit, the battery symbol will blink; this indicates that the battery needs charging. If the battery voltage is allowed to drop below that required for proper device operation, the display would be blank.

**NOTE:** This keypad can also be used to determine the battery status of the HI-4416. When the battery symbol is flashing, toggle the probe's ARM/OFF switch to OFF, if the symbol still blinks, then the battery in the System Readout needs charging.

**UNITS**

Instructs the probe to change the units of measure, and displays the new units. Continue to press the UNITS keypad until the desired unit of measure appears on the display. Just as for the RANGE command, the available units of measure depend upon which probe is connected to the System Readout; consult your probe manual.

**CLEAR DATA**

Clears all readings out of data log memory. To perform this operation, press and hold the CLEAR DATA keypad. The characters "clr" will flash on the display for approximately two seconds. Continue pressing the keypad until "000" appears on the display (these characters will not flash): data log memory is now cleared. When you release the keypad, the System Readout returns to the measurement mode.

**NOTE:** If this keypad is released while the "clr" characters are still flashing, data log memory is unaffected. This helps prevent accidental erasing of data.

**LOG**

Saves the current measurement in data log memory. Pressing the LOG keypad saves the reading in memory as this occurs, the readout momentarily displays the three-digit identification number of the reading. The data stored includes values, units of measure, over/under range indication and active axes. Up to 150 measurements may be stored. When data log memory is full, any additional LOG operations replace the value previously stored in location 150 with the new value; all other memory locations remain unchanged.

**NOTE:** If this keypad is pressed for longer than two seconds, the just-logged data is displayed.

**PREV**

The PREV key accesses the last value stored in data log memory. When the key is pressed: 1) the three-digit identification number of the stored value is displayed for approximately one second, then; 2) the stored value is displayed. The readout continues to display this value as long as the PREV key remains pressed. Approximately two seconds after releasing the key, the HI-4416 returns to the measurement mode. Successive operations of the PREV key decrement the displayed value toward the beginning of memory (value 001). If the key is pressed while viewing value 001, the readout "wraps around" to the highest stored identification number.

**NEXT**

The NEXT key accesses the next value stored in data log memory. The operation of this key is analogous to that of the PREV key, with the following exceptions: 1) successive operations of the NEXT key increment the displayed value toward the end of data log memory; 2) if the key is operated while viewing the highest stored value, the readout "wraps around" to identification number 001.

**NOTE:** If an under range value is logged and displayed, the measured value along with the under range indicator arrow will appear. If an over range value is logged and displayed, 'OL' and the over range indicator arrow will appear.

**X AXIS**

Commands the probe to enable/disable X axis measurements.

**Y AXIS**

Commands the probe to enable/disable Y axis measurements.

**Z AXIS**

Commands the probe to enable/disable Z axis measurements.

In some applications, it is advantageous to make field measurements along only one or two axes. These three keypads allow you to enable or disable each axis independently. The status of each axis is denoted by the "XYZ" axis identifier characters in the lower left corner of the LCD: if the axis identifier is visible, field measurement in that axis is enabled; if not visible, the axis is disabled.

### **4.3. BATTERY CHARGING**

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The HI-4416 System Readout contains a rechargeable nickel-cadmium (NiCd) battery. A fully charged battery (nominal output voltage of 3.6 VDC) provides up to 80 hours of operation. When the batteries have discharged to 3.3 VDC, the readout is still operational, but its battery needs charging: when the voltage drops below 3.18 VDC, the display will blank. Refer to the Note at the end of the description of BAT keypad operation in Section 4.2.

**NOTE:** ETS-Lindgren, charges the internal NiCd battery of the HI-4416 at the factory in order to test the System Readout prior to shipment. While every effort is made to ensure that your readout arrives ready to use, we cannot guarantee that this will be the case. Always check the condition of the readout's battery prior to making any measurements. To check readout battery voltage, refer to the operation of the BAT keypad in Section 4 of this manual.

### 4.3.1. Charging Procedure

**Step 1.** Plug the charger into a suitable AC source.

**Step 2.** Make sure power to the System Readout is OFF. Insert the plug from the charger cable into the readout's CHARGER jack.

**Step 3.** The battery pack is now charging. This may take approximately 1 hour, depending on how deeply the batteries are discharged. When charging is complete, the charger automatically goes into a trickle charge and will continue to do so until the probe is disconnected.

### 4.3.2. Battery Tips

NiCd batteries have several characteristics that can affect both their performance and operating life. The following tips advise you how to take advantage of these characteristics to get the most out of your System Readout's battery.

- Although NiCd batteries are rated for operation in temperatures from -20 °C to +65 °C (-4 °F to +140 °F), using the System Readout in extreme temperatures will reduce operating time significantly. The optimum operating temperature range for these batteries is +20 °C to +30 °C (+68 °F to +86 °F).
- The battery in the HI-4416 does not require periodic "deep discharges" to reverse the capacity-depleting "memory effect" caused by repeated shallow discharges. However, undercharging can reduce battery capacity.

- If the battery in the HI-4416 appears unable to acquire or maintain an appreciable charge, individual cells in the battery may be shorted or damaged. If, for any reason, your battery needs replacement, contact ETS-Lindgren Customer Service for assistance.

HI-4416 System Readout

Operation

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## 5. Maintenance

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This section explains those maintenance tasks that can be performed by the user. It also provides information regarding replacement and optional parts. If you have any questions concerning the maintenance of your system read out, consult ETS-Lindgren customer service.

### 5.1. Maintenance Recommendations

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Maintenance of the HI-4416 is limited to external components such as cables or connectors.

Any calibration or maintenance task that requires disassembly of the readout must be performed at the factory. Contact ETS-Lindgren customer service (+512.531.6445) before opening the unit to avoid problems with your readout's warranty.

**NOTE:** Opening the readout enclosure may void your warranty. If your system is still under warranty, contact ETS-Lindgren Customer Service before performing any maintenance inside the readout.

### 5.2. Upgrade Policies

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Periodically, readouts are upgraded to enhance functionality. These upgrades are commonly announced through ETS-Lindgren Engineering Bulletins.

### 5.3. Return Procedures

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To return an HI-4416 to ETS-Lindgren, use the following procedures:

Step 1. Briefly describe the problem in writing. Give details regarding the observed symptom(s), and whether the problem is constant or intermittent in nature. If you have talked previously to ETS-Lindgren Customer Service about the problem, provide the date(s), the name of the service representative you spoke with, and the nature of the conversation. Include the serial number of the item being returned.

Step 2. Package the System Read Out carefully. Use the original carry case if possible. If not, use the Parts List in Table 4 to order a new carry case from ETS-Lindgren.

If the readout is under warranty, refer to the Limited Warranty at the front of this manual for additional information about your return. Return your HI-4416 System Read Out, using the original packing materials (if possible), to:

**ETS-Lindgren, L.P.  
1301 Arrow Point  
Cedar Park, TX 78613 USA**

#### 5.4. Parts Information

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Use the tables below for ordering replacement (Table 4) parts for the HI-4416.

<b>Part Description (Replacement Parts)</b>	<b>Part Number</b>
Battery Pack, 3.6 VDC, Rechargeable	H-491038
Standard Fast Charger (115/230 Volt)	H-491198-36
Cable, Fiber Optic, Glass, 2 Meter	H-490994-02
Handle Assembly	H-491073
Carrying Case	H-491083
HI-4416 User's Manual	H-600050

**Table 4: Replacement Parts List**

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## 6. Warranty

### Scope and Duration of Warranties

Seller warrants to Buyer that the Holaday Brand Products to be delivered hereunder will be (1) free from defects in material, manufacturing workmanship, and title, and (2) conform to the Seller's applicable product descriptions and specifications, if any, contained in or attached to Seller's quotation. If no product descriptions or specifications are contained in or attached to the quotation, Seller's applicable product descriptions and specifications in effect on the date of shipment shall apply. The criteria for all testing shall be Seller's applicable product specifications utilizing factory-specified calibration and test procedures and instruments.

All product warranties, except the warranty of title, and all remedies for warranty failures are limited in time as shown in the table below.

Product Warranted	Duration of Warranty Period
Holaday Brand Products	1 Year

Any product or part furnished to Buyer during the warranty period to correct a warranty failure shall be warranted to the extent of the unexpired term of the warranty applicable to the repaired or replaced product.

The warranty period shall commence on the date the product is delivered to Buyer; however, if Seller assembles the product, or provides technical direction of such assembly, the warranty period for such product shall commence on the date the assembly of the product is complete. Notwithstanding the foregoing, in the event that the assembly is delayed for a total of thirty (30) days or more from the date of delivery for any reason or reasons for which Seller is not responsible, the warranty period for such product may, at Seller's options, commence on the thirtieth (30th) day from the date such product is delivered to Buyer. Buyer shall promptly inspect all products upon delivery. No claims for shortages will be allowed unless shortages are reported to Seller in writing within ten (10) days after delivery. No other claims against Seller will be allowed unless asserted in writing within thirty (30) days after delivery (or assembly if the products are to be assembled by Seller) or, in the case of alleged breach of warranty, within the applicable warranty period.

### Warranty Exclusions

Except as set forth in any applicable patent indemnity, the foregoing warranties are exclusive and in lieu of all other warranties, whether written, oral, express, implied, or statutory. EXCEPT AS EXPRESSLY STATED ABOVE, SELLER MAKES NO WARRANTY, EXPRESS OR IMPLIED, BY STATUTE OR OTHERWISE, WHETHER OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE OR USE OR OTHERWISE ON THE PRODUCTS, OR ON ANY PARTS OR LABOR FURNISHED DURING THE SALE, DELIVERY OR SERVICING OF THE PRODUCTS. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF.

Warranty coverage does not include any defect or performance deficiency (including failure to conform to product descriptions or specifications) which results, in whole or in part, from (1) negligent storage or handling of the product by Buyer, its employees, agents, or contractors, (2) failure of Buyer to prepare the site or provide an operating environmental condition in compliance with any applicable instructions or recommendations of Seller, (3) absence of any product, component, or accessory recommended by Seller but omitted at Buyer's direction, (4) any design, specification, or instruction furnished by Buyer, its employees, agents or contractors, (5) any alteration of the product by persons other than Seller, (6) combining Seller's product with any product furnished by others, (7) combining incompatible products of Seller, (8) interference with the radio frequency fields due to

conditions or causes outside the product as furnished by Seller, (9) improper or extraordinary use of the product, or failure to comply with any applicable instructions or recommendations of Seller, or (10) acts of God, acts of civil or military authority, fires, floods, strikes or other labor disturbances, war, riot, or any other causes beyond the reasonable control of Seller. This warranty does not cover batteries or any item that is designed to be consumable. Seller does not warranty products of others which are not included in Seller's published price lists for shielding products and systems supplies and accessories.

### **Buyer's Remedies**

If Seller determines that any product fails to meet any warranty during the applicable warranty period, Seller shall correct any such failure by either, at its option, repairing, adjusting, or replacing without charge to Buyer any defective or nonconforming product, or part or parts of the product. Seller shall have the option to furnish either new or exchange replacement parts or assemblies.

Warranty service during the applicable warranty period will be performed without charge to Buyer within the contiguous 48 United States during Seller's normal business hours. After the warranty period, service will be performed at Seller's prevailing service rates. Subject to the availability of personnel, after-hours service is available upon request at an additional charge. For service outside the contiguous 48 United States, travel and per diem expenses, when required, shall be the responsibility of the Buyer, or End User, whichever is applicable.

The remedies set forth herein are conditioned upon Buyer promptly notifying Seller within the applicable warranty period of any defect or nonconformance and making the product available for correction.

The preceding paragraphs set forth Buyer's exclusive remedies and Seller's sole liability for claims based on failure of the products to meet any warranty, whether the claim is in contract, warranty, tort (including negligence and strict liability) or otherwise, and however instituted, and, upon the expiration of the applicable warranty period, all such liability shall terminate. IN NO EVENT SHALL SELLER BE LIABLE TO BUYER FOR ANY SPECIAL INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND ARISING OUT OF, OR AS A RESULT OF, THE SALE, DELIVERY, NON-DELIVERY, SERVICING, ASSEMBLING, USE OR LOSS OF USE OF THE PRODUCTS OR ANY PART THEREOF, OR FOR ANY CHARGES OR EXPENSES OF ANY NATURE INCURRED WITHOUT SELLER'S WRITTEN CONSENT DESPITE ANY NEGLIGENCE ON BEHALF OF THE SELLER. IN NO EVENT SHALL SELLER'S LIABILITIES UNDER ANY CLAIM MADE BY BUYER EXCEED THE PURCHASE PRICE OF THE PRODUCT IN RESPECT OF WHICH DAMAGES ARE CLAIMED. This agreement shall be construed in accordance with laws of the State of Illinois. In the event that any provision hereof shall violate any applicable statute, ordinance, or rule of law, such provision shall be ineffective to the extent of such violation without invalidating any other provision hereof.

Any controversy or claim arising out of or relating to the sale, delivery, nondelivery, servicing, assembling, use or loss of use of the products or any part thereof or for any charges or expenses in connection therewith shall be settled in Austin, Texas by arbitration in accordance with the Rules of the American Arbitration Association, and judgment upon the award rendered by the Arbitrator may be entered in either the Federal District Court for the Western District of Texas or the State District Court in Austin, Texas, all of the parties hereto consenting to personal jurisdiction of the venue of such court and hereby waive the right to demand a jury trial under any of these actions

## **7. Addendum A: Communication Error Codes**

When the HI-4416 detects an error condition during communication with a probe, it will display an error message of the form EXX, where XX is a two-digit number. The meaning of each error number is described below. Under certain circumstances, it is possible for the user to correct the conditions causing errors 01 and 02: if not, or if the conditions that generate errors 03 - 12 develop and persist, the probe must be repaired by ETS-Lindgren technicians.

<b>Error 01</b>	No Response From Probe
<b>Cause:</b>	Probe's <b>ARM/OFF</b> switch in <b>OFF</b> position; faulty probe
<b>Error 02</b>	Transmission Error (e.g., Parity)
<b>Cause:</b>	The HI-4416 is <b>ON</b> , no fiber optic cables are connected, and the readout's connectors are aimed toward a light source; faulty probe
<b>Error 03</b>	Input Buffer Overflow
<b>Cause:</b>	Too many characters contained between the Start Character/Carriage Return sequence
<b>Error 04</b>	Invalid Start Character for Probe Data
<b>Cause:</b>	Start Character incorrect or not sent
<b>Error 05</b>	Probe Data String Length Error
<b>Cause:</b>	Data string does not conform to one of the two correct string lengths
<b>Error 06</b>	Invalid String for Reading Value
<b>Cause:</b>	Data string doesn't conform to correct format (four digits plus decimal point)
<b>Error 07</b>	Invalid Range Value
<b>Cause:</b>	Incorrect range character
<b>Error 08</b>	Invalid Unit Value
<b>Cause:</b>	Incorrect unit characters

HI-4416 System Readout Addendum A: Communication Error Codes

- |                 |                                     |
|-----------------|-------------------------------------|
| <b>Error 09</b> | Invalid Axis Enable Value           |
| <b>Cause:</b>   | Value is other than "E" or "D"      |
| <b>Error 10</b> | Invalid Battery Status Value        |
| <b>Cause:</b>   | Value is other than "N", "D" or "F" |
| <b>Error 11</b> | Over Range Indicator                |
| <b>Cause:</b>   | Value is other than "N" or "O"      |
| <b>Error 12</b> | Invalid Recorder Out Value          |
| <b>Cause:</b>   | Value is not in the range 0 – 255   |

## 8. Addendum B: HI-4416 Operating Protocols

Communication between the probe and the system read out is carried out via an ASCII data string.

The probe requires a dual fiber optic cable and only responds when commanded. The HI-4416 continuously (@ 7.6 Hz) sends the probe a command for data and waits for a response. If a key that requires information from the probe is pressed, the HI-4416 will send the appropriate command to the probe and wait for a response.

The probe data received by the HI-4416 can be in short format or long format. The short format ends with a carriage return after the unit designator.

### 8.1. Communication Protocol

Data Type:	RS-232 Serial
Data Mode:	Asynchronous
Word Length:	7 bits
Parity:	odd
Stop Bits:	1
Data Rate:	9600 baud

### 8.2. Probe Data Format

The data sent to the HI-4416 is formatted as follows:

SDxx.xuuugggobaaat

S Start Character (":")

D Type Indicator ("D" = Controller, "#" = Listen Only)

xx.xx Probe Reading (4 digits plus floating decimal)

uuu Units of Measure (See next page for valid unit indicators)

ggg Recorder Output/Bar Graph (0 - 255)

## HI-4416 System Readout Addendum B: HI-4416 Operating Protocols

- o Over Range Indicator ("N" = Normal, "O" = Over Range)
- b Battery Status ("N" = Normal, "W" = Warning, "F" = Fail)
- aaa X-,Y-,Z-Axis (respectively) enable flag ("E" = Enabled, "D" = Disabled)
- t Terminating Character (Carriage Return)

### 8.3. Valid Unit Types

---

The following table lists the unit codes that can be sent in the data string and the unit indicator displayed on the HI-4416. If an invalid unit code is sent to the HI-4416, no unit indicator is displayed and no error is generated. An underscore indicates a space character, and is significant.

Unit Code From Probe	HI-4416 Unit Display
_V_	V/m
_V2	[V/m]2
KV_	k[V/m]
KV2	k[V/m]2
_A_	A/m
_A2	[A/m]2
MA_	mA/m
MA2	m[A/m]2
_W2	W/cm2
MW2	mW/cm2
UT_	μT
NT_	nT
_G_	G
MG_	mG

**9. Addendum C:**  
**491198-36 Battery Fast Charger Manual**

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# Series 491198-36 NiCd Battery Fast Charger

User's Manual

## Declaration of Conformity

ETS-Lindgren, L.P.  
1301 Arrow Point Drive  
Cedar Park, TX 78613  
USA



Declares that the HOLADAY product described in this instruction manual is in compliance with: EN EMC Directive 86/336/EEC, EN50082-1, EN55011

**ETS-Lindgren, L.P.**  
**(Formerly Holaday Industries, Inc.)**



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Revision Record  
Manual #600086  
Series 491198-36 NiCd Battery Fast Charger

<u>Revision</u>	<u>Description</u>	<u>Date</u>
A	Release	4/99
B	Changed Area Code	2/00
	Updates	12/04

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## General Safety Considerations



This symbol alerts the user that important literature concerning the operation and maintenance of this unit has been included. Therefore, it should be read carefully in order to avoid any problems.

Warning

This is a Safety Class I product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor, inside or outside the instrument, is likely to make the instrument dangerous. Intentional interruption is prohibited. DO NOT defeat the earth-grounding protection by using an extension cable, power cable, or autotransformer without a protective ground conductor



This instrument is to be used with a three-wire power cord set which meets or exceeds the requirements of EN60799. The power cord set used must be rated for a minimum of 250V/10A. When connected to an appropriate power line outlet, this cable grounds the instrument cabinet

Warning



No operator serviceable parts exist inside the device. Refer servicing to qualified personnel. To prevent electrical shock, do not remove cover.

Warning



If this instrument is used in a manner not specified by ETS-Lindgren, the protection provided by the instrument may be impaired.

Warning



This battery charger incorporates parts, such as a switch and relay that potentially could produce sparks or arcs.

Warning



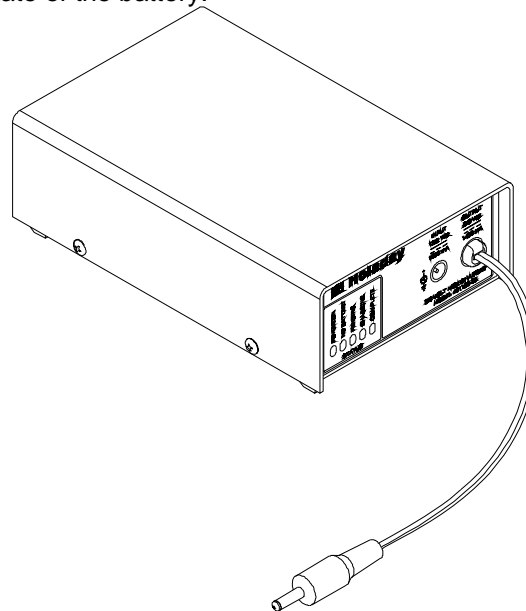
For indoor use only, do not expose to rain.

## Description

The 491198-36 NiCd Battery Fast Charger is a dual power source battery charger. It charges 3.6 volt 1400 mAh NiCd batteries and is powered by 120-240 Vac line power or 12.5 Vdc. The 491198-36 uses a  $-(dV)/(dT)$  (negative delta V) technique to determine when the battery is fully charged, typically one hour. With this technique, the charge state of the battery has no effect other than shortening the charge time.

Housed in a rugged enclosure, power enters the battery charger through a power entry module, which contains the fuses, or an optional cigarette lighter plug adapter. LEDs and the label on the front face of the unit provide operating status. The battery charger connects to the device being charged through a short cord terminated with a power jack.

An integrated circuit within the charger monitors the battery voltage and controls the charging functions according to the charge state of the battery.



**Figure 1: 3.6V Battery Charger**

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Addendum C:

## Unpacking and Acceptance

### Introduction

This section contains information on unpacking and acceptance of the 491198-36 NiCd Battery Fast Charger.

Step 1. Upon delivery of your order, inspect the shipping container(s) for evidence of damage. Record any damage on the delivery receipt before signing. In case of concealed damage or loss, retain the packing materials for inspection by the carrier.

Step 2. Remove the product from its shipping container. Save boxes and any protective packing materials for future use.

Step 3. Check all materials against the packing list to verify that the equipment received matches that which was ordered. If you find any discrepancies, note them and call ETS-Lindgren Customer Service for further instructions.

Be sure that you are satisfied with the contents of your order and the condition of your equipment before using it.

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Addendum C:

## Specifications

### Power

Main: IEC filtered AC power input module  
110 - 240 Vac, 500 mA MAX., 50 - 100 Hz  
Alternate: Automobile cigarette lighter to 2mm power plug  
adapter cord., 12.5 Vdc, 100 mA  
Fuses: 250 Volt, 1.0 Amp, Type T (5 mm x 20 mm)

### Output

Open Circuit Voltage: 15 Vdc  
Fast Charge Pending Current: 60 mA  
Fast Charge Current: 1400 mA  
Pulsed Trickle Charge Current: 50 mA  
Output Voltage (During Fast Charge): 3 - 6 Vdc

### NiCd Battery:

3.6 Volt 3 Cell NiCd Battery, 1400 mAh (Rapid charge cells, 1.2 volts/cell); ETS-Lindgren Part #491038

### Environmental

Operating temperature 10 to 40° C  
Humidity: 5% to 95% relative humidity, non-condensing

### Power Cable

This charger is shipped with a three-wire power cable. When this cable is connected to an appropriate AC power source, it connects the chassis to earth ground. The type of power cable shipped with each battery charger depends on the country of destination.

### Power Cable Set Information

ETS-Lindgren Part No.	Manufacturer, Part No. and Information
H-2217500	Volex #17500
	Type SVT, Foil shielded, PVC Jacketed, 60°C
	Molded PVC Grounding Plug NEMA 5-15P UC-004
	Molded PVC Receptacle IEC320/C13 UC-005
	18 Ga. 3 Cond. 10A-125V
H-2217506C	Volex #17506
	Type SVT, Foil shielded, PVC Jacketed, 60°C
	Molded PVC Grounding Plug NEMA 5-15P UC-004
	Molded PVC Right-Angle Receptacle
	IEC320/C13 UC-006
	18 Ga. 3 Cond. 10A-125V Countries: Canada, Japan, Puerto Rico, Taiwan, Venezuela, Hong Kong, United States
H-221100	Kobiconn #173-7001
	Type H05VV-F, PVC Jacketed, 70°C
	Molded PVC Right-Angle Grounding Plug CEE 7/7 UC-814
	Molded PVC Receptacle IEC320/C13 UC-051
	1.0mm <sup>2</sup> 3 Cond. 10A-250V
	Countries: Argentina, Austria, Brazil, Finland, France, Germany, Israel, Italy, Holland, Korea, Netherlands, Norway, Sweden, Turkey
H-222600	QualTek #370001-E01
	Type H05VV-F, PVC Jacketed, 70°C, Harmonized
	Molded PVC Grounding Plug BS 1363, Fused UC-851
	Molded PVC Receptacle IEC320/C13 UC-852
	1.0mm <sup>2</sup> 3 Cond. 10A-250V
	Countries: England, Ireland, Malaysia, Scotland, Singapore, South Africa, Wales

ETS-Lindgren Part No.	Manufacturer, Part No. and Information
H-221600	Leeds Electronic Components #FFBS-1310 Type SAA, Ordinary Duty, PVC Jacketed, 75°C Molded Grounding Plug AS3112 UC-822 Molded PVC Receptacle IEC320/C13 UC-051 1.0mm <sup>2</sup> 3 Cond. 10A-250V Countries: Australia, China
H-221500	Volex #2102H-C3-10 Type H05VV-F, PVC Jacketed, 70°C Molded PVC Grounding Plug SEV 1011 UC-841 Molded PVC Receptacle IEC320/C13 UC-051 1.0mm <sup>2</sup> 3 Cond. 10A-250V Country: Switzerland

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Addendum C:

## Operating Instructions

The 491198-36 battery charger is intended to charge the 3.6 volt NiCd batteries, either in the lab or in the field.

### Input Power Requirements

The 491198-36 charger may be powered by standard line voltage (110 - 240 Vac, 50 - 60 Hz) or by an optional automobile cigarette lighter plug (12.5 Vdc), see specifications. The AC power entry module contains a fuse.

### Fuse Replacement

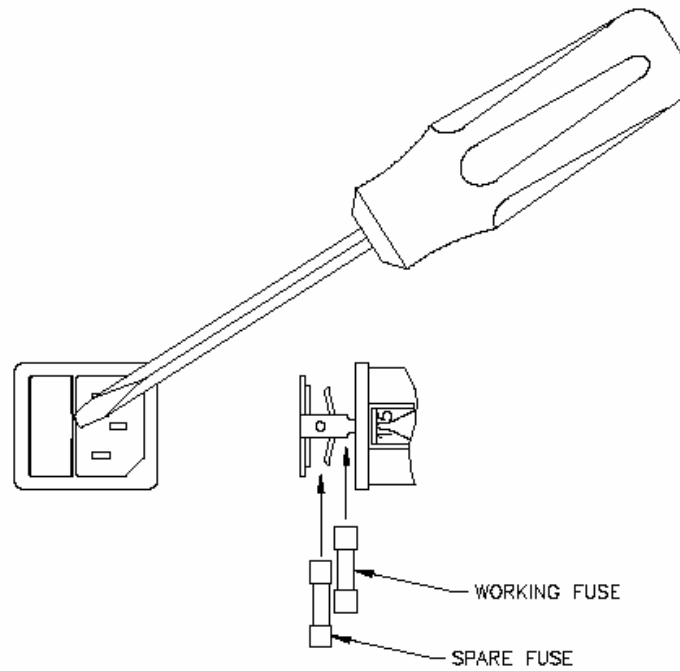
If a fuse has blown, it must be replaced with the same type and value or an unsafe condition may result. Refer to Figure 2 for fuse replacement.

The fuse is contained in the fuse drawer in the power input module. To access the fuse, use a screwdriver to pry the drawer open and remove it from the module. The drawer holds two fuses; the fuse towards the outside of the drawer is a spare.

After the fuse has been replaced, slide the fuse drawer back into the module. Make sure that it snaps securely into its locked position.

**CAUTION**

NEVER attempt to change the fuse with the battery charger plugged in.



**Figure 2: Fuse Replacement**

## Charging a Battery

After connecting the battery charger to a proper power source, the battery charger simply plugs into the charger jack on the HI-6005. The HI-6005 must be turned off or the battery will not charge.

### **CAUTION**

NEVER attempt to recharge a non-rechargeable battery.

## Charging Indicators

There are five LEDs located on the front of the charger that provide operating information to the user.

The “POWER ON” LED (green) will remain illuminated as long as the charger is plugged into the AC power source.

If the charger does not detect a battery, the “NO BATTERY” LED (amber) light will illuminate.

When the charger does detect the unit’s battery, the “PENDING” LED (amber) light illuminates while the charger qualifies the battery for fast charge. If the voltage is below the safe fast charge level, the battery is charged in the pulse trickle mode.

When the voltage is at a safe level the charger will switch to the fast charge mode and the “CHARGING” LED (amber) light illuminates.

When charging is complete, the charger switches back to the pulse trickle mode and the “COMPLETE” LED (green) light will illuminate. The device can be left on the charger in this maintenance mode indefinitely.

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Addendum C:

## Maintenance

Electronic instruments are delicate. Operate the battery charger with care.

User serviceable parts do not exist inside the battery charger. Warranty may be void if the battery charger housing is opened.

If the battery charger fails to operate, check for a blown fuse inside the power entry module (refer to figure 2).

<b>CAUTION</b>
----------------

NEVER attempt to change the fuse with the battery charger plugged in.

If a fuse is blown it must be replaced. Be sure to use only 250 Volt, 1.0 Amp, Type T (5 mm x 20 mm).

If the battery charger still fails to operate, or if you have any questions concerning charging your products, contact ETS-Lindgren Customer Service.