Instruction Bulletin - 01.4IB.48050B
Shipping Data Logger
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Signal Words

As stated in ANSI Z535.4-2007, the signal word is a word that calls attention to the safety sign and designates a degree or level of hazard seriousness. The signal words for product safety signs are “Danger”, “Warning”, “Caution” and “Notice”. These words are defined as:

- **DANGER**: DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

- **WARNING**: WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

- **CAUTION**: CAUTION, used with the safety alert symbol, indicates a hazardous situation which, if not avoided, could result in minor or moderate injury. CAUTION, used without the safety alert symbol, is used to address practices not related to personal injury.

- **NOTICE**: NOTICE is used to address practices not related to personal injury.

Qualified Person

For the purposes of this manual, a qualified person, as stated in NFPA 70E®, is one who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved. In addition to the above qualifications, one must also be:

1. trained and authorized to energize, deenergize, clear, ground, and tag circuits and equipment in accordance with established safety practices.
2. trained in the proper care and use of personal protective equipment (PPE) such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices.
3. trained in rendering first aid if necessary.
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Ch 1  General Information

⚠️ WARNING

The equipment described in this document may contain high voltages and currents which can cause death or serious injury.

The equipment is designed for use, installation, and maintenance by knowledgeable users of such equipment having experience and training in the field of high voltage electricity. This document and all other documentation shall be fully read, understood, and all warnings and cautions shall be abided by. If there are any discrepancies or questions, the user shall contact Powell immediately at 1.800.480.7273.

⚠️ WARNING

Prior to adjustments, servicing, maintenance, or any act requiring the operator to make physical contact with the equipment, the power source must be disconnected and the equipment grounded. Failure to do so may result in death or serious injury.

⚠️ NOTICE

The information in this instruction bulletin is not intended to explain all details or variations of the Powell equipment, nor to provide for every possible contingency or hazard to be met in connection with installation, testing, operation, and maintenance of the equipment. For additional information and instructions for particular problems, which are not presented sufficiently for the user’s purposes, contact Powell at 1.800.480.7273.

⚠️ NOTICE

Powell reserves the right to discontinue and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.
A. Scope

The information in this instruction bulletin describes the installation and usage of the Shipping Data Logger (SDL).

B. Purpose

The information in this instruction bulletin is intended to provide information required to properly operate and maintain the Shipping Data Logger described in Ch 1 General Information, A. Scope.

This instruction bulletin provides:

1. Safety guidelines
2. General descriptions of the operation and maintenance of the Shipping Data Logger
3. Instructions for installation
4. Instructions to initiate the shipment log
5. Shipment status check
6. Recycling of the device
7. Illustrations, photographs, and description of the shipping data logger.

The illustrations contained in this document may not represent the exact construction details of the Shipping Data Logger. The illustrations in this document are provided as general information to aid in showing component locations.

All illustrations and photos are shown using deenergized equipment.

C. Instruction Bulletins Available Electronically

Changes to the instruction bulletin may be implemented at any time and without notice. Go to powellind.com to ensure use of the current instruction bulletin for Powell equipment.

For more information visit powellind.com. To contact the Powell Service Division call 1.800.480.7273 or 713.944.6900, or email info@powellservice.com.

For specific questions or comments pertaining to this instruction bulletin email documents@powellind.com with the IB number in the subject line.
Ch 2 Safety

A. Safe Work Condition

The information in Section A is quoted from NFPA 70E 2012 - Article 120, 120.1 Establishing an Electrically Safe Work Condition.

120.1 Process of Achieving an Electrically Safe Work Condition

1. Determine all possible sources of electrical supply to the specific equipment. Check applicable up-to-date drawings, diagrams, and identification tags.

2. After properly interrupting the load current, OPEN the disconnecting device(s) for each source.

3. Wherever possible, visually verify that all blades of the disconnecting devices are fully OPEN or that drawout type circuit breakers are withdrawn to the fully disconnected position.

4. Apply lockout/tagout devices in accordance with a documented and established policy.

5. Use an adequately rated voltage detector to test each phase conductor or circuit part to verify they are deenergized. Test each phase conductor or circuit part both phase-to-phase, and phase-to-ground. Before and after each test, determine that the voltage detector is operating satisfactorily.

Informational Note: See ANSI/ISA-61010-1 (82.02.01)/UL 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 V and below.

6. Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or circuit parts before touching them. Where it could be reasonably anticipated that the conductors or circuit parts being deenergized could contact other exposed energized conductors or circuit parts, apply ground connecting devices rated for the available fault duty.

B. Safety Guidelines

Study this instruction bulletin and all other associated documentation before installing the Shipping Data Logger.

Each user has the responsibility to instruct and supervise all personnel associated with usage, installation, operation, and maintenance of this equipment on all safety procedures. Furthermore, each user has the responsibility of establishing a safety program for each type of equipment encountered.

The safety rules in this instruction bulletin are not intended to be a complete safety program. The rules are intended to cover only some of the important aspects of personnel safety related to the Shipping Data Logger.
C. General

Only supervised and qualified personnel trained in the usage, installation, operation, and maintenance of the equipment in which the Shipping Data Logger is installed shall be allowed to work on the equipment. It is mandatory that the appropriate instruction bulletins, supplements, and service advisories be studied, understood, and followed.

D. Specific

Due the variability of equipment in which the shipping data logger can be installed, refer to the instruction bulletin of the equipment containing the SDL for specific safety instructions.

E. Safety Labels

The equipment described in this document may have DANGER, WARNING, CAUTION, and instruction labels attached to various locations. All equipment DANGER, WARNING, CAUTION, and instruction labels shall be observed when the equipment is handled, operated, or maintained.

**NOTICE**

Warning and Caution labels are located in various places. Do not remove or deface any of these warning/caution labels.
Ch 3  Equipment Description

A. General

NOTICE

Powell is committed to continuous product improvement.

It is possible that improvements occurred between revisions to this document and therefore, may not be described in these instructions. If the equipment does not resemble the photographs and descriptions contained herein, contact Powell before attempting to perform any actions.

1) Temperature/Humidity Port

The temperature/humidity port is located behind the port (Figure 1, a). It allows for sensing of current environmental conditions.

2) Push Button

The button (Figure 1, b) on the face of the SDL is used to initiate logging of a shipment and to check the status of a shipment during or after shipment has been made.

3) LED Indicator

Depending on the situation, a red, green, or yellow light will be visible. See Table A SDL LED Indicators for the situation and corresponding LED indicator.

<table>
<thead>
<tr>
<th>Situation</th>
<th>LED Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shipment Initiated</td>
<td>Red Flashing for 5 Seconds then Solid Green for 3 Seconds</td>
</tr>
<tr>
<td>Status Check - No Damage</td>
<td>Solid Green for 3 Seconds</td>
</tr>
<tr>
<td>Status Check - Damage</td>
<td>Solid Red for 3 Seconds</td>
</tr>
<tr>
<td>Shock Detected</td>
<td>Red Flashing for 60ms</td>
</tr>
<tr>
<td>USB Mode</td>
<td>Yellow Flashing (continuous)</td>
</tr>
</tbody>
</table>

4) Micro USB Port

The USB port (Figure 1, d) on the SDL is used to access the log data stored on the device. The USB port receives a Micro USB plug and can be used to power the device in order to retrieve the data in case the battery life has expired.
Figure 1  Shipping Data Logger

- **a.** Temperature/Humidity Port
- **b.** Push Button
- **c.** LED Indicator
- **d.** Micro USB Port
Ch 4 Installation

A. Receiving

When the shipping data logger is received check for any sign of damage. If damage is found or suspected, file all claims immediately with the transportation company and notify the nearest Powell representative.

Estimated size and weight for shipping a Shipping Data Logger:

- Size: 4.1” wide x 1” deep x 1.3” high
- Weight: 55g (2oz)

B. Storage

Shipping and storage of electrical equipment requires measures to prevent the deterioration of the apparatus over a long unused period. It is recommended the SDL be stored in a dry, indoor location prior to installation. The storage environment should be between -40°C/-40°F to +85°C/+185°F.

C. Mounting

The SDL is mounted to the shipment using either two 1/8” rivets through the baseplate mounting holes or by using the SDL’s adhesive backing.

1) Mounting Using Rivets

Figure 2 shows the mounting hole pattern in case holes need to be made for the fasteners. A #30 drill bit is recommended if holes are to be drilled.

2) Mounting Using Adhesive Backing

To obtain optimum adhesion, the surface must be clean and dry. The surface should be cleaned using denatured alcohol, applied using a lint free cloth. The surface must be thoroughly dried prior to mounting the SDL.

Bond strength is dependent upon the amount of adhesive-to-surface contact developed. Firm application pressure develops better adhesive contact and helps improve bond strength.

To ensure secure fastening with the adhesive backing, remove the paper strip and press the SDL firmly onto the desired location for one minute. The adhesive backing used is McMaster Carr Part Number 76665A83 (3M™ VHB™ Foam Tape - Adhesive on Both Sides, #4905, 0.020” thick).
3) **Recommended Mounting Locations**

It is recommended that the shipping data logger be mounted in the following locations as shown in *Figure 3*:

a. **Circuit Breakers:**
   - near the rear of the truck on the lower frame
   - close to tags if existing
   - clear of mechanical interface points
   - away from potentially live components (minimum 7 inches from exposed medium voltage conductors)
   - clear of bolts or other hardware
   - provide sufficient spacing to permit ease of connection of USB mini

b. **Instrument Compartments:**
   - clear of any relays and terminal strips
   - clear of door hinges
   - place on a non-moving surface
   - provide sufficient space to permit ease of connection of USB mini

c. **PCR®:**
   - place on vertical wall a minimum of 8 feet from an external door
   - mount on the largest free section of the wall available
   - a minimum of 5 feet from any AC unit
   - mount the SDL approximately 4 to 5 feet above the floor
Figure 3  Recommended Mounting Locations

PowlVac® 5kV & 15kV Circuit Breaker

PowlVac® 5kV & 15kV Ground & Test Device

PowlVac 38® Circuit Breaker

PowlVac-ND® Circuit Breaker

Power/Vac® 5kV & 15kV Circuit Breaker

Instrument Compartment
Ch 5  Operation

A. Starting a Shipment Log

Once the device is mounted, the SDL can be initiated to record shipping data. Press the push button (Figure 1, b) on the face of the SDL. The indicator LED will blink red for 5 seconds, then go solid green for 3 seconds. Once initiation has begun the green light will go off. This indicates that the SDL has begun recording data for the shipment and shipping can commence.

B. Checking a Shipment

In order to check a shipment to determine if damage has occurred as during shipment, press and hold the push button (Figure 1, b) on the face of the SDL. An indicator light (Figure 1, c) will illuminate to display the status of the shipment.

- If a green light is displayed, the shipment occurred within allowable bounds for the shipment.
- If a red light is displayed, the temperature, humidity, or shock the device was exposed to during shipment exceeded allowable limits and damage may have occurred to the product.

The log data may be downloaded and inspected to determine when the damage may have occurred.

C. Retrieving Log Data

1) Power the Device

If the battery in the SDL has expired, the device will still receive power from the USB plug in order to operate the device for downloading.

2) Download Log Data

To download the shipping log data from the SDL, the device must be plugged into a Windows-based computer using a Micro USB connection. Once plugged in, the computer should recognize and install it as a “Mass Storage Device” (Figure 4). The Mass Storage Device will contain a single “SDL” file (Figure 5) which will have the logged shipping data for customer review.

Figure 4  Recognized Shipping Data Logger

Figure 5  Stored Log Data

Note: This file cannot be opened directly without having the Shipping Data Logger Interface Application installed.

The SDL Interface Application can be accessed by going to powellind.com. Download the file and run the application (Figure 6). After the Interface has been opened, click the “Import SDL FILE” button (Figure 7) and select the stored log (Figure 5).
Figure 6  SDL Interface Application

Figure 7  Shipping Data Logger Interface

a. Import SDL File Button

After the data has been imported, the options of viewing the graphs of the recorded data or exporting the data into a CSV data sheet become available.

Figure 8  SDL Post Import Options

Figure 9  Temperature & Humidity Graph

Figure 10  Shock Damage Index Graph

The shock damage index is a way of combining data from all nine bins for easy viewing, with the intent to assist in determining where “rough” portions of shipping may have occurred.

Each bin is assigned a severity weighting and for each log entry the counts “x” severity for each bin are summed, and the result is plotted.

The severity weighting is based loosely on the bins’ energy content found by multiplying mean duration and acceleration of each bin.
3) CSV File Formatting

If CSV file is chosen for export, a prompt asking the final destination of the file will appear. After the data has been exported, browse to the selected destination and open the RPT file that was generated. An example of the .CSV log file received from the data is shown in Figure 12. The Bin Columns (#B1-#B9) indicate the number of shocks in a particular bin during an hour period. The Max(g) column lists the maximum shock that occurred during the recording internal. Temperature (Temp) and Relative Humidity (RH) data are also stored hourly.

Figure 12 Exported .CSV File

D. ACCELEROMETER FUNCTIONS

1) Shock Severity Binning Explanation

The shock bins are based on the duration as well as the magnitude of the shock events that occur during a shipment. There is a 3g wake up level for the on-board microcontroller. When the 3g threshold is exceeded by a shock event the microcontroller wakes up and begins to measure the duration of the first shock pulse as well as the maximum “g” level obtained. The shock event is checked to see which bin it fits in based on its “g” level and the duration. The bins contain the number of times a shock within that range has occurred during the shipment. The low “g” column is in the range of 4 to 8 g, the medium “g” range is from 8 to 12 g, and the high “g” range is from 12 to 16 g. The duration ranges are from 2.5 to 20ms for short duration, 20 to 50ms for medium duration, and from 50 to 500ms for long duration. For each recording interval the number of events that occurred within each bin is logged as well as the maximum “g” level that occurred during that interval. Figure 13 shows the bins graphically.
Potential for damage to a shipment can be determined by the duration and level of a shock. As seen by the gradient in Figure 13, the potential for damage is highest in bin 9 shown by the red color, and reduces as the “g” levels and duration decrease. A 16 g shock with duration of 500ms has a much greater potential to do damage than a 4 g shock with a 2.5ms duration.

2) Random Vibration / $G_{\text{RMS}}$ Explanation

$G_{\text{RMS}}$ is a measurement of the random vibration level that the SDL experiences. The measurement is a 20 second sample that occurs once per hour. The $G_{\text{RMS}}$ value compliments shock measurements as it provides an alternative interpretation of the acceleration levels that the SDL is exposed to.

Many shipping standards base their test levels on statistics of random vibration measurements of products in transit. A common way the standards depict this data is through a power spectral density plot (PSD). Due to limitations of the shipping sensor this is not feasible to record or measure. Standards usually provide, in addition to the PSD plot, the overall level of the PSD in $G_{\text{RMS}}$. The $G_{\text{RMS}}$ value is measured by the shipping sensor and can be compared directly to the values provided in standards. ASTM D4169-14 “Performance of Shipping Containers and Systems” contains PSD break points for truck, rail, and air shipping test levels, as well as the overall levels ($G_{\text{RMS}}$) of the PSD plots. For reference, in ASTM D4169-14 the highest overall test level is for air transport at 1.49 $G_{\text{RMS}}$.
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