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FD-2000

Battery Fault Detector
Instruction Manual

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FD-2000 BATTERY FAULT DETECTOR

GENERAL DESCRIPTION

The battery fault detector FD-2000 is a low-cost, permanently installed sensing device that detects and alarms on critical battery system failures.

The FD-2000, when connected to a battery in full float operation, detects the following problems:

Open Circuit - Loss of charge current due to a badly deteriorated or open conduction path.

Charger Voltage - Hi or low voltage condition due to charger failure or voltage regulation problems.

Ground Fault - A leakage path of less than 40K ohm to earth ground from either the positive or negative bus.

SPECIFICATIONS

Power Requirement:	115 VAC; Less than 100 MA
Input Voltage:	0 - 199.9v
Alarm Setpoints:	15v to 165v
Ground Fault Setpoint:	Fixed at 40K ohms +/- 5K ohms @ 132v
Current Sensor:	Ripple sensing unit or true D.C. milliamp sensor available
D.C. Panel Meter:	3½ digit display Reading accuracy is +/- 300 MV (worst case) over the full reading range
Alarm Contacts:	Form C rated 2 AMP at 28V DC or 115 VAC Can be configured to energize or de-energize on alarm condition
Overall Dimensions:	8" x 5.5" x 2.25"
Mounting Config.:	Wall mount

SYSTEM DESCRIPTION

Voltage sensing is implemented using standard voltage comparator techniques. The outputs from the Hi and Lo comparator circuits are logically Or'ed before driving the alarm relay.

Ground fault detection is implemented by comparing the voltage from either side of the battery to ground. A fixed resistor network normally keeps the voltage to ground at exactly half of the overall, but this level offsets as leakage paths to ground develop. A leakage path of approximately 40k ohms will cause an alarm output from the comparator circuit.

Current sensing is accomplished using a magnetic sensor that detects the ripple component of the charger current flowing through the battery. The sensor reliably detects very low ripple amplitudes and should work with every charger presently in use in the power industry.

The ripple current detector is a simple, reliable device that is essentially an absence or presence type detector. This device is well-suited for this application, where actual D.C. value is not important (float charge current is not normally used as a diagnostic or long-term trending parameter).

An alternate, more expensive D.C. current transducer is available for systems that are completely ripple free, or where the user is interested in measuring the actual D.C. value of the charge current. The D.C. transducer is also a magnetic device that measures the magnetic field strength generated in a toroidal core that the current carrying conductor is threaded through.

Either magnetic sensor can withstand the high currents associated with a discharge.

Each of the three main instrument functions has an alarm relay associated with it. These relays can be jumper selected to either operate in a normally energized or normally de-energized condition, or operate in a latched/non-latching mode. All output contacts are Form C rated 2 AMP continuous @ 120 VAC/DC.

All local alarm indicators will latch until manually reset.

The relay action for the voltage and ground fault function is almost immediate following an alarm condition. There is a small filter circuit delay that protects against nuisance alarms from transients.

The relay action for the Power Fault will change state when power is removed from the FD-2000.

The open circuit relay action has a 5-6 minute delay built in to allow for momentary disturbances such as tripping breakers or returning the charger voltage to float from equalization level.

The alarms can be reset locally by pressing a reset push-button switch or remotely by using a SCADA contact connected to terminals 1 & 2 on the FD-2000.

The FD-2000 is physically packaged in a small painted metal enclosure designed for wall mounting. An optional rack mount enclosure will be available in the future.

BATTERY FAULT DETECTOR INSTRUCTIONS

INTRODUCTION

This document describes, in detail, how the FD-2000 Battery Fault Detector works and the proper method of operation. It is recommended that all personnel responsible for the use of this instrument read this document in its entirety prior to actual use.

The Battery Fault Detector FD-2000, when connected to a battery as shown in Figure I, will detect the following problems:

Charger Voltage Out of Tolerance - High and low voltage thresholds.

Open Circuit/High Battery Resistance - Loss of battery charging current due to a badly deteriorated or open conduction path.

Ground Fault - A leakage path to earth ground of less than 40k ohm from either the positive or negative bus.

When no alarm conditions exist, the steady, green NORMAL indicator LED will be illuminated. When an alarm condition occurs, one or more of the red, blinking indicator LED's will be illuminated, and the corresponding alarm relay contacts will change state.

I. INSTALLATION

The FD-2000 includes an electronics unit, which is designed to be wall mounted, and a current sensor, which is strapped to the main battery cable.

The current transducer should be tightly strapped to a cable that is part of the main battery conduction path using standard nylon cable ties passed through the holes at the four corners of the sensor. Initially, however, the sensor will have to be rotated for installation testing, so it should not be secured to the battery cable until after the necessary measurements have been taken. The sensor can be attached to one of the main leads connecting the battery to the DC bus or to one of the intertier cables. Make sure that the transducer is physically located at least six (6) feet from the charger or any other AC equipment, such as station service transformer banks, that can produce a strong alternating magnetic field.

2. CONNECTING TO THE FD-2000

2.1 Battery Voltage

Warning! To reduce the risk of electrical shock the overall voltage leads that actually connect to the battery bus must be connected last. Do not attempt to connect the leads to the battery and then to the FD-2000. These connections are close enough to each other that possible short circuit could occur.

Connect sense leads from the terminals marked BATTERY "+" and "-" (Terminals #17 and #18, respectively) to the positive and negative DC bus potentials. The bus connections can be made at any convenient DC load center or terminal block. For safety reasons, make sure to terminate at the positive potential through the fuse assembly provided by ALBERCORP.

2.2 Current Sensor

Connect low sensitivity terminals 1 and 2 of the sensor to the electronics unit terminals 15 and 16, labeled SENSE "+" and "-", respectively. Pin 1 should go to the "+" input. If the low current sensor option is provided, refer to Appendix A.

2.3 AC Power

Connect the AC lines to the terminal strip labelled AC Hi, AC Lo, and GND*, respectively. (* If ground fault detection is not required, then leave this connection open.)

2.4 Remote Reset

Connect the terminals labeled REMOTE RESET 1 & 2 to a SCADA system contact or push-button switch that can be used to reset the alarm circuit remotely. This is an optional input that is in parallel with the local reset push-button switch.

2.5 Alarm Relays

All alarm relays incorporate Form C contacts with normally open contacts (N.O.) and normally closed contacts (N.C.) brought out to the terminals of the electronics unit, as shown in Figure 1.

Refer to Appendix B for alternate relay operation.

3. ADJUSTING ALARM THRESHOLDS

3.1 Battery High Voltage

Set the panel meter selector switch to the HIGH VOLTS position and use the HIGH VOLTS potentiometer to adjust the high voltage setpoint to the desired alarm level. When DC bus voltage exceeds this setpoint, the red VOLTAGE FAULT indicator LED will blink and the voltage alarm relay will operate.

3.2 Battery Low Voltage

Set the panel meter selector switch to the LOW VOLTS position and use the LOW VOLTS potentiometer to adjust the low voltage setpoint to the desired alarm level. When DC bus voltage falls below the setpoint, a red VOLTAGE FAULT indicator will blink, and the voltage alarm relay will operate.

3.3 Battery Open Circuit - Ripple Sensing

Set the panel meter selector switch to the INPUT position, and turn the INPUT potentiometer all the way counterclockwise. Position the current sensor as shown in Figure 2a, with leads connected to terminals 1 and 2.

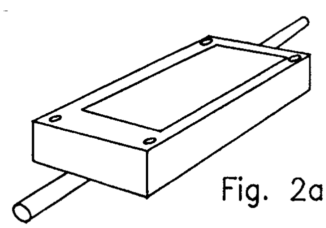

Fig. 2a

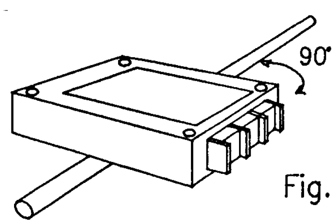

Fig. 2b

Slowly turn the INPUT potentiometer clockwise until the meter reads approximately 1000. (If the INPUT potentiometer is adjusted too quickly the meter may overrange, displaying a "1" followed by three blanks (1_ _ _), in which case just turn the potentiometer counterclockwise to proceed). If the maximum reading attainable is less than 1000 counts, reconnect the sensor leads for high sensitivity (sensor terminals 1 and 3) and repeat the adjustment until the desired reading is obtained.

Next, imagine a line connecting the centerpoint of the sensor label side with the centerpoint of the opposite side and rotate the sensor 90 degrees around this line to the position shown in Figure 2b. The meter reading should decrease to less than 50% of the previous reading.

On rare occasions, when the meter reading does not decrease at least 50% upon rotating the sensor 90 degrees, then an externally produced, ambient magnetic field is overriding the field of the AC component of battery charging current in the cable. Such an overriding field could be produced, for example, by a heavily loaded station service power transformer located just outside the wall of the battery room. Try relocating the sensor to another section of battery cable. If attempts at relocation are unsuccessful, then contact ALBERCORP.

Reposition the sensor as in Figure 2a, and secure it to the battery cable with wire ties, as shown in Figure 1. Check and, if necessary, adjust the INPUT potentiometer for a meter reading of 1000 +/- 40. Lastly, set the selector switch to the THRESHOLD position and adjust the THRESHOLD potentiometer for a meter reading of 500 +/- 20.

If the maximum meter reading is less than 1000 counts but greater than or equal to 800, then adjust the threshold for 50% +/- 20 counts of the maximum reading. If the maximum reading attainable is below 800, then the battery charger at your installation may not be suitable for the ripple-sensing current sensor; the optional low current sensor may be required. Please contact ALBERCORP for further assistance.

When the AC component of the battery charging current drops below the threshold level, after approximately 5-6 minutes, the blinking, red OPEN CIRCUIT indicator LED will be illuminated, and the open circuit alarm relay will operate. The AC component of the charging current will be reduced for any of the following three conditions:

1) A decrease in the output power of the battery charger.

2) A significant decrease in the normal DC system load current.

3) An increase in the impedance of the battery charging path.

If the output of the charger is too low to charge the battery, as in the case of a loss of AC input power to the charger, then the battery will no longer charge, but will act as a source, discharging power into the DC system load. Since battery discharge current is a true DC quantity, the sensor will not sense any AC component. A voltage alarm may or may not be present, depending upon the level of degradation of charger output and the length of time the charger function has been impaired. If the battery circuit impedance is normal, then, once the charger is restored to normal operation, all alarms should clear.

Likewise, a planned, significant reduction in the normal load current on the DC system will cause a corresponding reduction in the magnitude of the AC component of battery charging current. If such a reduction in load is effected, it will be necessary to readjust the INPUT reading on the electronics unit to 1000 +/- 40.

However, if the open circuit alarm is present and charger output voltage is within +/- 1 volt of the normal float level, then a high resistance or open circuit condition is indicated. An ALBERCORP CELLCORDER can then be used to pinpoint the location of the high resistance component in the battery string.

To test the open circuit alarm at any time, simply turn the selector switch to TEST; an open circuit alarm will follow when the sensor is moved 90° to the cable - refer to Figure 2b. Note: In the test mode, the 5-6 minute delay is disabled.

3.4 Ground Fault

The ground fault detection thresholds are fixed internally. Prior to testing the ground fault detector, it should be verified that no ground fault presently exists on the battery. Measure each end of the battery with respect to earth ground and note the voltage readings. If the magnitudes of the two measurements differ by more than 20 volts, then there is already a path to ground of sufficiently low resistance to interfere with the operation of the ground detection circuit, and this condition should be corrected before the ground detection circuit is connected.

If a ground fault preexists when performing a function test, then the ground fault resistance will conflict with the test resistance that is installed. For example:

> If a ground fault of 50K preexists on the battery and a test resistance of 100K is simulated, then the fault seen by the FD-2000 is the parallel equivalent of these, being 33.3K. This will cause an alarm.

To test the operation of ground fault alarm, first connect a 100K ohm resistor between earth ground and either side of the battery; no alarm should appear. Next, connect a 30k ohm resistor in the same manner; the red GROUND FAULT indicator LED will blink, and the ground fault alarm relay will operate.

APPENDIX A

OPTIONAL CD-2 INSTRUCTIONS

INTRODUCTION

In some applications where the AC charger ripple is too low for the conventional detector, the optional CD-2 should be used. This device will monitor the actual DC charging current of the system. However, the value indicated on the FD-2000 is not an actual DC current value, it is a number representing the DC current relative to the preset alarm threshold of 500 counts. Typically this input value is set to 1000 counts, 50% higher than the alarm threshold.

The threshold value has been preset at the factory to 500 counts. By changing this threshold value to 750 counts, it would increase sensitivity by 25%; and by adjusting the threshold to 250, it would decrease sensitivity by 25%. For example:

FD-2000 Threshold Adjustment Value	FD-2000 Input Adjustment Value	DC Charging Current	DC Charge Current Alarm Trigger Point
750	1000	40 ma	30 ma
500	1000	40 ma	20 ma
250	1000	40 ma	10 ma

When the CD-2 is installed and calibrated, it should be done under normal float conditions when the charge current is at a minimum.

INSTALLATION

The CD-2 is provided with its own power transformer and therefore should be installed as close as possible to an AC outlet. The CD-2 sensor requires the current-carrying conductor to pass through its toroidal-shaped core. The aperture diameter is 1.25 inches. To avoid interrupting the battery's conduction path while installing the sensor, install a temporary parallel jumper around the section of cable where the sensor will be installed. Then, disconnect an intertier cable or one of the main leads connecting to the battery, and pass the cable through the sensor aperture with the "+" side to the positive end of the charger; then reattach the connector.

2. CONNECTION

Make the following connections between the sensor, power transformer and FD-2000 using a wire no larger than #18 AWG.

Sensor Terminal	Power Transform Terminal	FD-2000 Terminal
1 Supply voltage +	+	
2 Supply voltage -	-	
3 Output signal -		12 sense +
4 Output signal +		13 sense -

3. ADJUSTMENT

The unit is supplied from the factory with the INPUT adjustment fully clockwise and the threshold value set to 500 counts. When setting the panel meter selector to INPUT, the display will probably indicate an overrange condition displaying a 1 followed by three blanks (1_ _ _). If the meter indicates less than 800 counts then adjust the INPUT clockwise to achieve 1000 counts. If this cannot be achieved, a more sensitive sensor is required.

If is displayed, adjust the INPUT level counterclockwise to a reading of 1000 counts.

Next, set the panel meter selector to threshold and adjust to 500 counts.

4. TESTING

To verify that the unit will trigger on low charging current, one of two tests can be performed. In the first test, the charger can be turned off; and in the second, the panel meter selector can be moved to the TEST position and rotate the sensor by 90° to cancel the input signal. (Note: In the test mode the 5-6 minute delay is disabled.) The meter will indicate a true reading of what the unit is detecting. After approximately 5-6 minutes, the OPEN CIRCUIT alarm will activate.

APPENDIX B

FD-2000 JUMPER SETTINGS

1B FACTORY DEFAULT SETTING

AC ripple detector Model CD-1

JP7 - jumper pins 2 & 3
JP8 - jumper pins 2 & 3

2B Optional low current sensor Model CD-2

JP7 - jumper pins & 2
JP8 - jumper pins & 2

3B FACTORY DEFAULT SETTING

Alarm relays will be de-energized in a normal condition.

Note: The description of contacts on the connector label indicates contact position in a non-alarm state.

JP1	OFF
JP2	ON
JP3	ON
JP4	OFF
JP5	ON
JP6	OFF

4B Alarm relays will be energized in a normal condition.

Note: The description of the contacts on the front panel indicates contact position in an alarm condition.

JP1	ON
JP2	OFF
JP3	OFF
JP4	ON
JP5	OFF
JP6	ON

5B Alarm relays configured to latch under an alarm condition.

JP9 - jumper pins 2 & 3
JP15 OFF

6B **FACTORY DEFAULT SETTING**

Alarm relays will self-reset when fault is cleared.

JP9 - jumper pins & 2
JP15 ON

Note: Alarm indicators on front panel will always latch and must be manually reset.

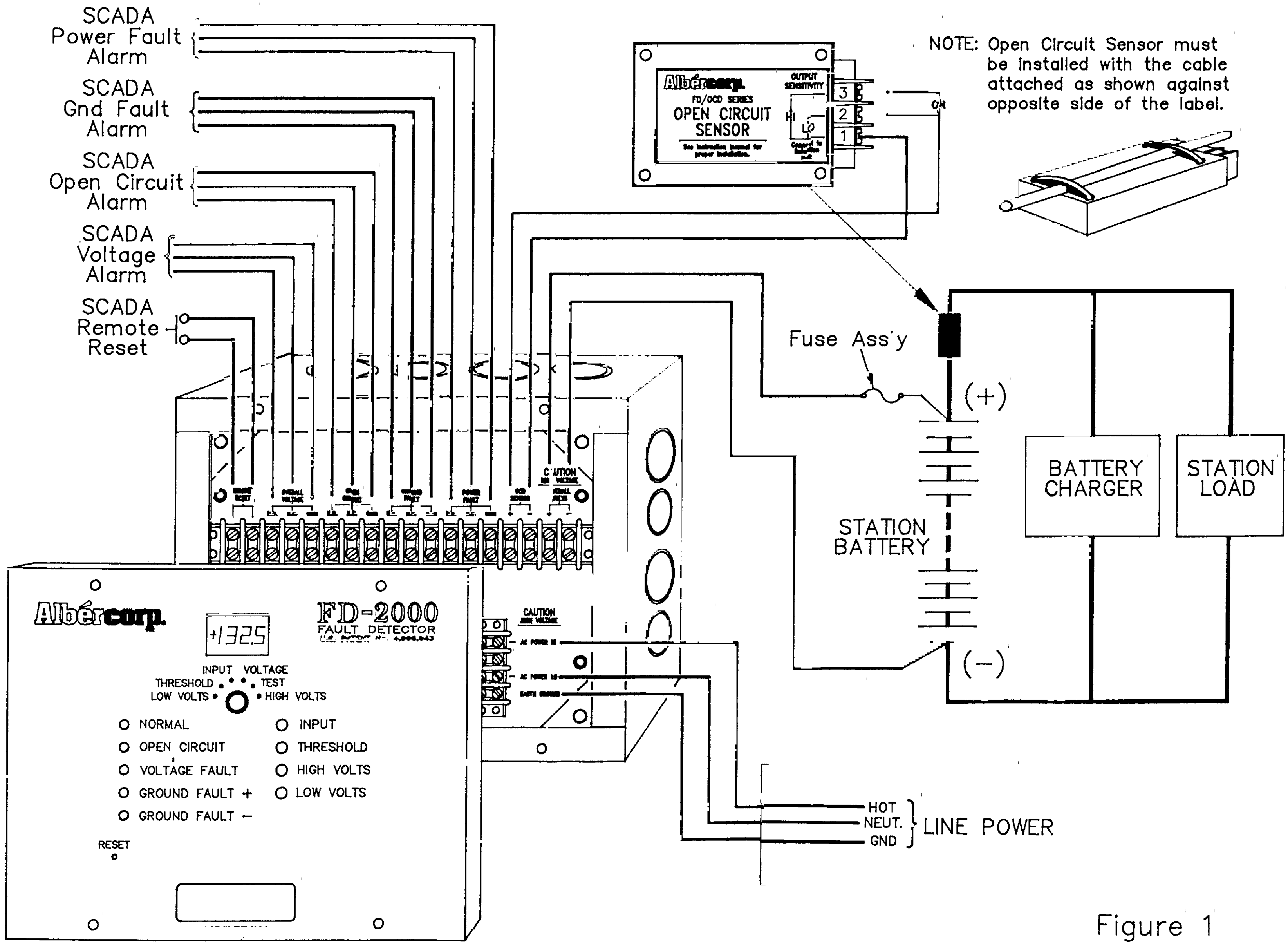
SCADA Power Fault Alarm
SCADA Gnd Fault Alarm
SCADA Open Circuit Alarm
SCADA Voltage Alarm
SCADA Remote Reset
Albércorp.
FD/OCD SERIES
OPEN CIRCUIT SENSOR
OUTPUT SENSITIVITY
HI
LO
3
2
1
OR
NOTE: Open Circuit Sensor must be installed with the cable attached as shown against opposite side of the label.
Fuse Ass'y
(+)
(−)
STATION BATTERY
BATTERY CHARGER
STATION LOAD
CAUTION
Albércorp.
+132.5
FD-2000
FAULT DETECTOR
INPUT VOLTAGE
THRESHOLD
TEST
LOW VOLTS
HIGH VOLTS
NORMAL
OPEN CIRCUIT
VOLTAGE FAULT
GROUND FAULT +
GROUND FAULT −
INPUT
THRESHOLD
HIGH VOLTS
LOW VOLTS
RESET
HOT
NEUT.
GND
LINE POWER

Figure 1