

## ISD-80, ISD-420-EM-A, ISD-420-EM-B Operational Description

### Overview

The ISD Series of emergency lighting battery packs from IOTA Engineering have been designed to ensure that the pack is always ready in the case of the need for emergency lighting. It accomplishes this by continuously monitoring the charge circuit and battery voltage and performing its own periodic functional testing at intervals and durations that meets or exceeds regulatory standards for emergency battery packs. The ISDs also contain additional features that make installation and use more convenient. Among these features are a single wire to connect the un-switched power source from 120 to 277VAC at 50 or 60Hz, occupation awareness sensing that serves to prevent testing during times when the room or office is occupied, a time delayed enabling of the normal AC ballast to help ensure that the unit is compatible with almost any type and manufacture of AC ballast, and a watch dog timer that will reset the micro-controller should it ever lock up or freeze due to code execution errors or electrical line irregularities.

### Installation

The ISD battery pack should be installed using the installation instructions and wiring diagrams included in the instruction manual. When this is complete, the ORANGE wire will be connected to the un-switched power source and the BLACK wire will be connected to the switched (or un-switched if applicable) source that is used to operate the AC ballast normally. The BROWN wire then powers the AC ballast. This way the ISD will be able to properly determine the operating voltage (120 to 277) and the occupancy status (when applicable) by sensing the light switch condition.

### Details

When the unit connectors are not connected, the ISD is in a sleep state and consumes a negligible amount of current. When the unit connectors are mated, the ISD awakes and reads some configuration data from the EEPROM. This data includes a random 'Days' variable that is set between 1 and 28 at the factory and is thereafter incremented once every 24 hours while the unit is operating. A random test number is also set at the factory and is between 1 and 12. The ISD then initializes the I/O pins and a pseudo real time clock that will keep track of seconds, minutes, hours, days, and months. Once the initialization is complete, the unit will enter the **Start Up** state where it will perform the following functions:

- Determine the charge current to the battery.

- Determine the reason for start up (i.e. unit connectors mated, battery failed during a test or emergency, the watchdog timer timed out, or a test completed).

Once the charge current is stable between the upper and lower threshold charge currents, the ISD unit will enter the **Charge** state where it will spend the vast majority of its life. In the **Charge** state, the unit will continuously perform the following functions:

- Light the LPTS 'green' to indicate the unit is operating normally.

- Enter the **Emergency** state if a loss of AC power is detected.

- Monitor the charge current and battery voltage.

- Update the pseudo real time clock (PRTC).

- Monitor and update the status of the lighted push button test switch (LPTS).

- Compare the PRTC day with 26. If it is equal to or greater than 26 set the unit will perform a test within 2 days.

- Monitor the occupied status line, the hours to charge variable, and the hour's unoccupied variable. If all these are clear, it is OK to Test.

If the OK to Test flag is set and the Test Due flag is set, then the appropriate test is initiated (Test #1-11 are 30 Sec and Test #12 is 90 Min) and the Test # is incremented. The unit will switch to the **Testing** state.

Monitor the state on all the Test Fail indicators and report a fail code via the beeper and LPTS if applicable.

While in the **Charge** state, the ISD will also transmit data via the LPTS LED once per minute. When transmitting data, the LPTS will appear to flash 'red.' This also serves as a 'heart beat' indicating the processor is operating normally. Once per day, the ISD will store the state of all flags, variables and PRTC data. This data is also saved prior to entering the **Emergency** or **Test** states. This way, in the case of a battery failure and subsequent processor reset, the unit can determine status prior to reset and act accordingly.

The **Emergency** state is entered into due to the processor detecting a charge current below a preset threshold. When AC is removed, the switchover relays will switch immediately due to the lack of coil current through the relays. The processor detects the loss of a current and disables the external AC ballast, then waits a short interval for the contacts to settle and then enables the inverter and holds off the relays. While in the **Emergency** state, the unit will perform the following functions:

The LPTS will be Green or Off depending on the state of charge.

Monitor the current available from the AC line. When this current has crossed the AC on the threshold continuously for a preset time period (to avoid repetitive short cycling) the ISD will disable the inverter, engage the relays and, after a short interval to allow the contacts to settle, enables the external AC ballast. The unit will then return to the **Charging** state.

The **Testing** state is entered into either by manually being initiated by the LPTS (30 second tests only) or automatically determined by the built-in schedule. The test duration for scheduled tests is prescribed by the test number (30 Seconds for test numbers 1-11 and 90 Minutes for test number 12). When this state is entered, the ISD will disable the external ballast, wait a short interval, disengage the switching relays, and enable the inverter. While the unit is in the test state, it will perform the following functions:

The LPTS will be Green or Off depending on the state of charge.

Monitor the inverter frequency.

Monitor the battery voltage.

Monitor the test time remaining.

The test will end if the frequency or the battery voltage is outside the prescribed range for more than 10 readings or the test time expires. If the test ends due to failure, a flag will be set causing the alarm to sound out and flash the failure code every 15 seconds. In the case of a test failure, the unit will retest itself within 2 days. When the Test state is exited, the unit will disable the inverter and engage the relays. After a short interval to allow the contacts to settle, the external AC ballast is re-enabled.

To disable the alarm, press and hold the test switch for 5 seconds. Address the cause of alarm, then wait 1 minute. Depress the test switch to initiate a manual test. The unit will then reset.

## **Additional Features**

Some tasks not directly associated with any particular state run continuously in the background and accomplish some of the most important features of the ISD Series emergency battery pack.

First, there is the Pseudo Real Time Clock (PRTC). This is a software-based clock that runs on an interrupt derived from the divided-down operating clock source. While not extremely accurate, it is much more accurate than is required in this application and requires no additional hardware external to the processor itself which

enhances reliability and cost-effectiveness. (An external Real Time Clock will be available as an option).

Second, there is the watchdog timer. This is hardware timer that operates from its own oscillator and will generate a processor reset if it is not attended to by the operating code prior to its time out period. This adds an extra level of protection from code or processor lock-ups due to virtually any cause be it code error, power supply abnormality, or hardware function.

Third is the unit "state saving" function that periodically saves the state of all variable and flags from volatile to non-volatile memory. This ensures that in the case of an unexpected reset the processor can determine why it reset and what was going on when it reset, making it a simple task to restore the current state of operation.

Fourth is the Alarm and Report function that will sound and flash a code if there is any existing failure\*. The alarm function will beep a predetermined code for each of the failure modes every 15 seconds. In the event of multiple failures, each code will be separated by about 1 second. Pressing the LPTS switch will temporarily silence the audible alarm.

Fifth is the data transmission. All of the current data is transmitted once per minute via the LPTS status LED. This includes the PRTC all flags, battery voltage, charge state, charge current, and inverter frequency.

\*The ISD tests the functions of the emergency system components. It does not test the AC ballast, incoming power to the AC ballast, or any lamp(s) not designated for emergency operation.

### **ISD-80/ISD-420-EM-A/ISD-420-EM-B Trouble-Shooting Guide**

By far the most common problems encountered with the ISD units are due to incorrect or incomplete wiring. So even if you are sure the unit is wired correctly, please double and/or triple-check the wiring compared with the applicable wiring chart included with the manual. The second most common problem is the batteries having an insufficient charge to perform a test. Please allow the batteries to charge for at least 24 hours before initiating a test. 100% of ISD units are fully tested prior to leaving the factory, so the odds are very small that a unit is defective. The following is a list of some of the known installation problems:

**The LED is Red and never turns Green** - Two conditions will make this happen. The first and most obvious reason is that the polarity of the LED is wrong. Make sure that the dot on the LED is on the side connected to the Red wire. The second reason is that the ISD detected a failure. If this is the case, monitor the LED for a few moments. Every 15 seconds, the LED will flash and the buzzer will beep a certain number of times (either 1, 2, 3, or 4 - most common is 3). This is an indication of an open lamp connection, a bad lamp, or the wrong kind of lamp.

**The AC ballast doesn't light the lamps** - Ensure that the Black wire for the ISD is connected to the power source for the AC ballast and that the Brown wire from the ISD is connected to the AC ballast's hot connection. Also make sure that the lamp wires are correctly connected to the ISD, AC ballast, and the lamp(s).

**The LED seems to flash or flicker every minute or so** - This is perfectly normal and is a visual indication ("heart-beat") that the ISD is alive and well. In the case of errors, the LED will be Red and flash every 15 seconds or so.

**The fluorescent lamp repeatedly turns on and off in emergency mode** - This is due to a discharged battery. Apply AC power to the ISD for a minimum of 24 hours prior to use.

