Using the…

IntelliLogger™
IL-Mini

Data Logging and Alarming Instrument

Logic Beach Incorporated
Phone: 619.698.3300 / Fax: 619.469.8604 / www.logicbeach.com

Document Revision History:

6-1-2012: Initial release

10-13-2014: Additional information on the PSM-4 added

Contents

1 INTELLILOGGER IL-MINI ™ INSTRUMENT OVERVIEW

USER MANUAL ORGANIZATION

The user instructions for the IntelliLogger IL-Mini™ Portable Data Logging System consist of two manuals:

IL-MINI INSTRUMENT MANUAL (THIS MANUAL)

Provides details on the actual instrument installation, operation and wiring.

HYPERWARE-II™ SOFTWARE MANUAL

Provides detailed instruction on installation and use of the HyperWare-II software for communication between a PC and the IL-Mini, programming, real-time data viewing and logged data download

IL-MINI™ SYSTEM "THE BIG PICTURE"

The IntelliLogger IL-Mini™ (Figure 1-1) is a rugged, low-power stand-alone instrument that samples analog, digital and optionally Modbus inputs from various signals and sensors, processes the readings per a user defined program, then stores the readings to internal memory for later analysis. In addition to data acquisition, the IL-Mini can simultaneously perform local alarming.

With its rugged design, it is well suited to most environments ranging from industrial plant floors to vehicle to outdoor environments. As a low-power instrument, it is well suited to battery operation. The IL-Mini finds itself equally at home as a permanent data acquisition and alarming system or a remote field temporary test data logging instrument.

Figure 1-1; IntelliLogger IL-Mini™

The IL-Mini is used in concert with the HyperWare-II software, which facilitates programming, display of real-time readings from a connected IL-Mini and data download and review. HyperWare-II features visual,

icon-based programming (Figure 1-2), an intuitive and quickly learned programming method unique to Logic Beach instruments.

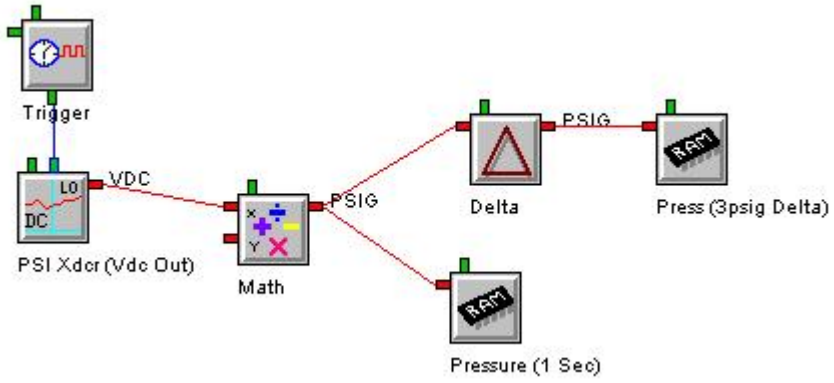

Figure 1-2; Icon Based Programming feature of HyperWare-II

IL-MINI OPTIONS

An array of order-time options is available for the IL-Mini instrument. This allows the IL-Mini to be purchased with a feature set best suited to the application and budget. Options for the IL-Mini include liquid crystal display, internal batteries and sensor excitation power supplies, expanded analog input ranges and signal types, various outputs, Modbus RTU interface and more. Details on the order-time options are covered in their respective sections.

FCC NOTICE

FCC INFORMATION

This equipment complies with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference

2. This device must accept any interference received, including interference that may cause undesired operation.

INTERFERENCE

The FCC limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.

- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician to help.

2 IL-MINI ™ ENCLOSURE AND MOUNTING

ENCLOSURE

The IL-Mini is provided in a plastic gasketed door NEMA-4X equivalent, clear door enclosure. To open the enclosure, press down on the front door face to compress the door gasket while flipping the black plastic latch plate away from the enclosure. Once the clear front door is open, the USB connector, CF card socket and front panel buttons can all be accessed.

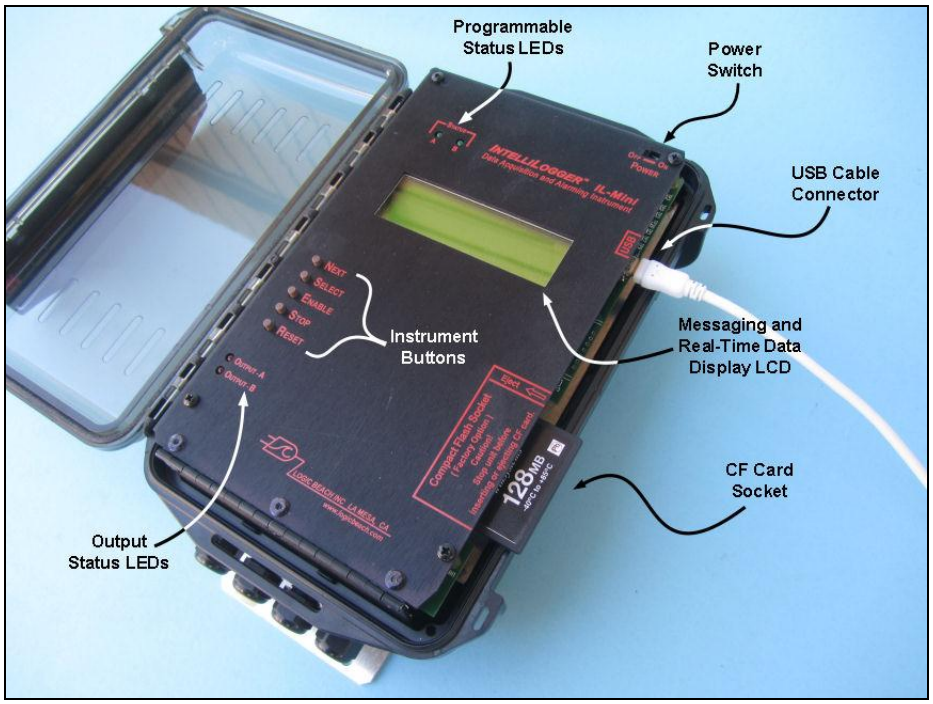

Figure 2-1; IL-Mini with Door Open

INTERNAL ACCESS

To gain internal access to make wiring connections to the IL-Mini, configure input channels, access internal fuses as well as to access the internal batteries (option), remove the two thumbscrews at the top of the unit (Figure 2-2)

Figure 2-2; Removing the Front Panel retaining thumbscrews

The front panel can then be rotated open around the hinge at the bottom of the unit (Figure 2-3).

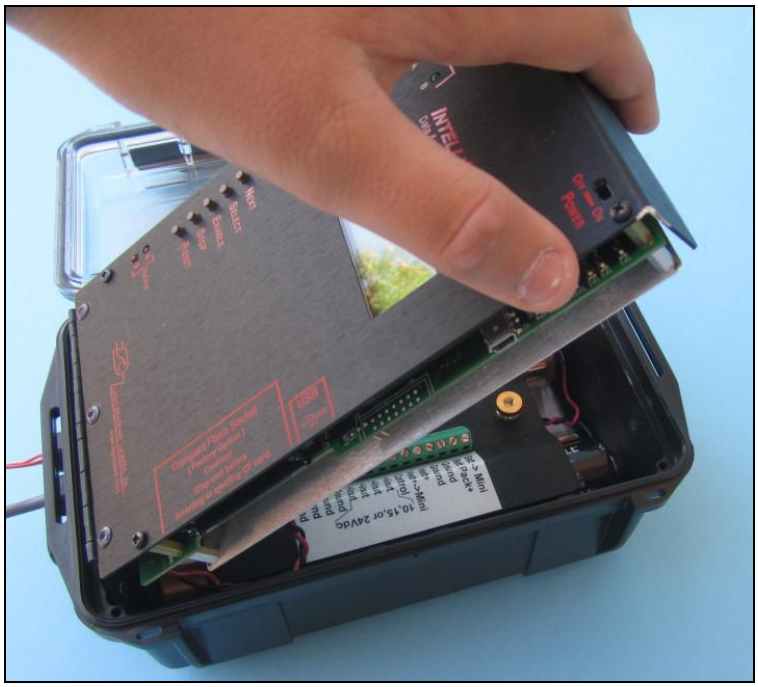

Figure 2-3; Opening hinged Front Panel

ESD Precautions

As with all electronic instruments, the IL-Mini can be damaged by electro-static discharges. Protective circuitry is integral to the IL-Mini to protect the unit from damage however when the unit is hinged open, more vulnerable circuitry is exposed.

To minimize the chance of unit damage when the IL-Mini is hinged open:

1. Discharge any charge on your body before touching the IL-Mini by first touching a grounded surface, appliance, conduit, pipe, etc.

2. Always touch the aluminum shield (printed with wiring instructions) when first coming in contact with the IL-Mini after movement away from the unit. This will equalize the static charge between your body and the IL-Mini in a safe method.

WIRING EGRESS

Power and signal wiring enters the enclosure via sealing gland fittings which are provided with the unit at time of purchase. The gland fittings are user installed in the bottom end of the unit (Figure 2-4). During installation of the fittings, best fit is insured by aligning the flats of the nuts (inside the enclosure) parallel to the flats of the neighboring nut. Secure the gland fitting in place with a wrench from the outside. Do not over-tighten as the fittings are plastic and the threads can be stripped.

Route wiring through the gland fitting and insure that the gland fitting compression nut is tightened down to compress the internal gland seal onto the wire insulation. Proper compression can be

determined by tugging on the wiring… the wiring should not slip within the fitting. Best results come from using multi-conductor cable with an external jacket. Wiring connection details are covered in Chapter 3.

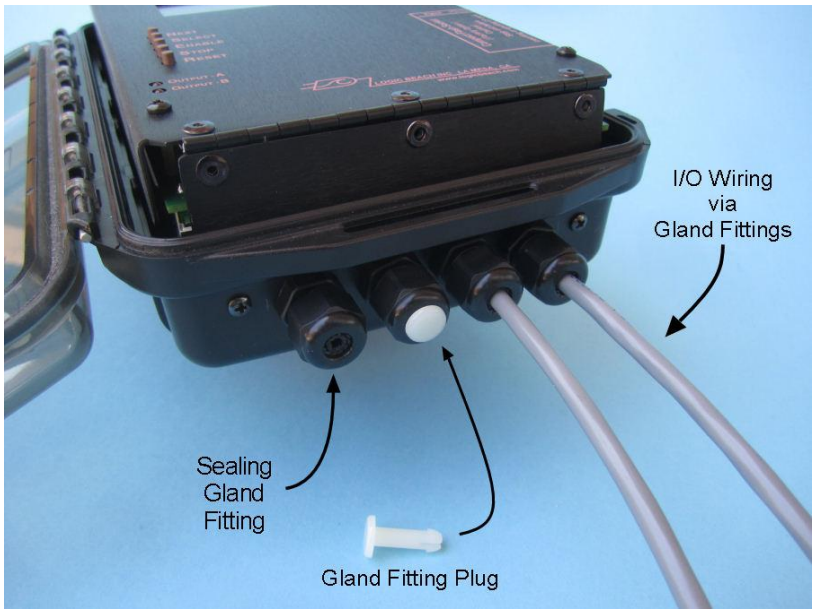

Figure 2-4; Gland Fittings and I/O Wiring

To maintain best protection from the elements, it is advised that all gland fittings be installed in the IL-Mini and fittings that do not have wiring in them be plugged with the provided Gland Fitting plugs (Figure 2-4) in place of wire.

TERMINAL STRIP WIRING CONNECTIONS

The Wiring Panel that is exposed when the IL-Mini is hinged open (Figure 3-2) identifies the connections for the exposed terminal strip. Depending on order-time options, all 21 physical terminal strip connections may or may not exist. Additionally, in some cases, the physical terminal strip connections may exist but the function is not enabled. Before wiring, insure that you are aware of the options included in this specific IL-Mini.

> Note: A listing of the installed features and options can be determined via a Status Query from the HyperWare-II software. Refer to the HyperWare-II Software Manual for details.

Chapter 3 provides wiring details for the various I/0.

INTERNAL WIRE ROUTING

Route the signal wiring through the gland fittings as described in above and loop them back to the terminal strip. Provide a sufficient loop to allow for flexure of the leads as the front panel is hinged open and closed.

BATTERY ACCESS

On units supplied with the optional internal D-cell batteries, once the front panel is hinged open, the batteries can be accessed. To change the batteries, turn the IL-Mini front panel power switch OFF, remove the two thumb-nuts on the battery retainer plate and remove the retainer plate.

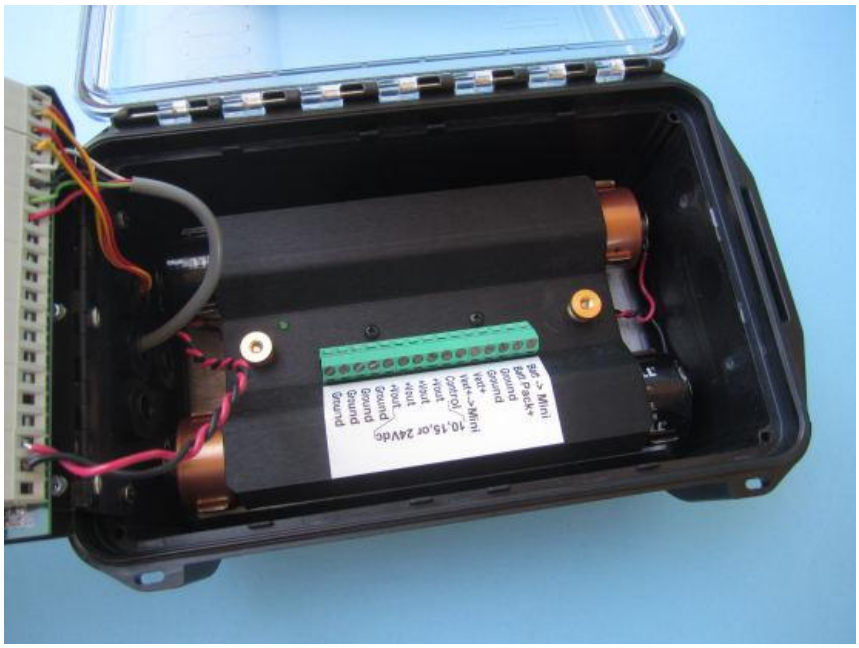

Figure 2-5; Battery access (shown with optional PSM-4 Power Supply)

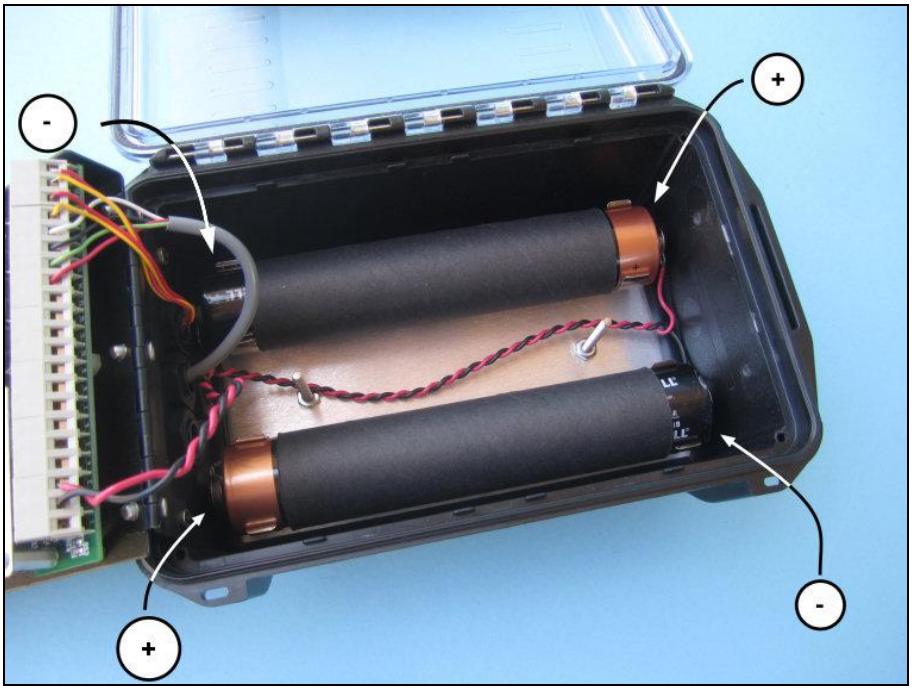

Figure 2-6; D-cell battery access and polarity (battery retainer plate removed)

Note that if the IL-Mini is equipped with the PSM-4 option, the plate will be attached with a tether of wires to the battery holders. In that case, let the battery plate gently dangle from the wire tether during the battery replacement step. The batteries can then be pulled from their battery brackets and new batteries installed. Observe polarity upon reinstallation of the batteries and insure that they are securely in place,

then replace the battery retainer and thumb-nuts. The thumb-nuts should be tightened sufficiently to slightly compress the foam under the battery retainer plate against the batteries. Do not over-tighten.

ENCLOSURE SURFACE MOUNTING

The IL-Mini can be wall or surface mounted using the optional Surface Mount bracket (PN 3539.22000). The Surface Mount Bracket (Figure 2-7) first attaches to the back of the IL-Mini then can be fastened to the surface via the 4 mounting holes.

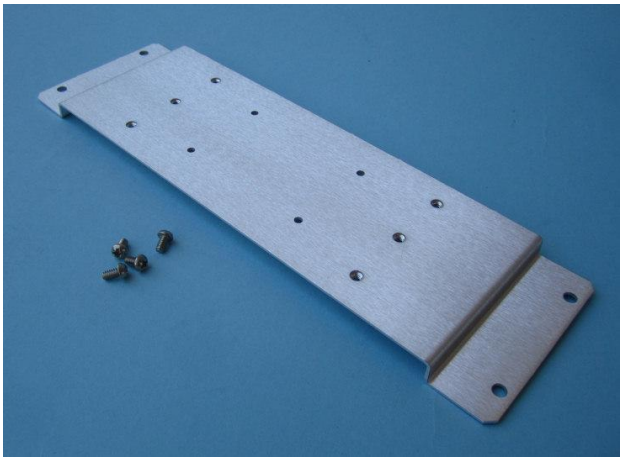

Figure 2-7; Surface Mounting Bracket

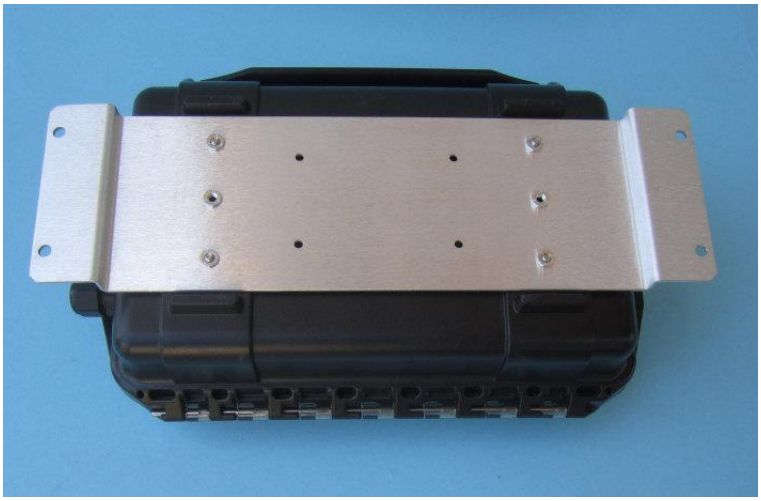

Figure 2-8; IL-Mini shown with Surface Mounting Bracket installed

To attach the bracket to the back of the IL-Mini, access must be gained to the inside back face of the IL-Mini plastic enclosure. Machine screws (provided with bracket) are then installed from the inside of the enclosure, through the back face and into the threaded inserts in the surface mounting bracket.

Installation steps follow:

1. Power down the IL-Mini and remove the two front panel retaining thumbscrews at the top end of the enclosure. Hinge the unit open.
2. If the unit includes the D-cell battery option, the battery assembly must be removed. If the unit does not have the D-cell option, skip to Step 4.

3. The complete battery plate assembly can be removed in one piece by removing the four machine screws that are located in each corner on the outside back of the enclosure. Once removed, the battery pack can be set aside. If more convenient, it may be easier to remove the wiring connecting the battery pack to the IL-Mini terminal strip such that the battery assembly is no longer tethered to the the IL-Mini.
4. There are four holes in the back of the IL-Mini enclosure that are sealed with an elastomeric sealant. Using a sharp tool such as an awl or pencil, make a penetration through the seals. It is not necessary to completely open the holes or remove the sealant.
5. From the inside of the enclosure, insert the machine screws provided with the bracket into the holes in the sealant and while holding the bracket against the back outside face of the IL-Mini, screw the machine screws into the threaded inserts on the mounting bracket and tighten them securely.

Figure 2-9; Surface Mounting Bracket installation

6. Reinstall the battery assembly if so equipped and close the hinged front panel. Reinstall the two front panel retaining thumbscrews.
7. The unit can now be mounted to the surface/wall.

3 INPUTS AND OUTPUTS

Power, input signal and alarm output wiring is connected to the IL-Mini via the internal terminal strip. Channel configuration for range and type of signal input is performed via four DIP switches and during the IL-Mini programming via HyperWare-II software configuration dialogs. Following are details of each of the Input and Output types and associated wiring.

Note

Many of the Inputs and Outputs in the IL-Mini are order time options. Your instrument may or may not have Input/output options described below.

POWER AND GROUND

The IL-Mini requires low-voltage (7-30Vdc) external power or connection to the optional internal D-cell battery pack to operate. External power can be provided from sources such as batteries or the optional 120Vac to 12Vdc power adapter (PN DCXFR-12V-1A) or 120Vac to 24Vdc power adapter (PN DCXFR-24V-1A).

TERMINAL STRIP CONNECTIONS

Terminal 2 is GND and can be shared between the optional internal batteries (negative terminal) and an external DC source (negative terminal). If the D-batt option is installed, a black conductor from the battery pack may already be connected to this terminal.

Terminal 3 and terminal 4 are the positive power inputs. These two inputs are identical although labeled for battery (Vbatt) and External power (Vdc+) connections. The IL-Mini will consume current from whichever terminal is sourced with the higher voltage. For example, if the internal D-cells (nominal 9Vdc) are connected to terminal 3 and a 12Vdc adapter is connected to terminal 4 , then in normal operation, the IL-Mini will run from the 12Vdc source and automatically fall back to the batteries if the external power fails.

The inputs are diode protected to prevent inadvertent damage from reversed polarity connection to either the Vbatt or Vdc+ terminals and Gnd.

CHASSIS GROUND

For optimum system accuracy and protection of the IL-Mini from electrostatic discharge damage in permanent or semi-permanent applications, it is highly recommended that an Earth ground connection be made to Terminal 1 (ChGnd) of the terminal strip. Ideally a short wire will be connected from this terminal to a known Earth ground connection such as an electrical panel ground in industrial environments or a ground rod driven 6' into the Earth in outdoor/remote installations. Ensure that the lead does not have excessive length or coils as this adds inductance and lessens the effective protection.

GENERAL PURPOSE DIGITAL INPUT CHANNEL (GPDI)

All IL-Mini models are equipped with one General Purpose Digital Input (GPDI) channel. This is non-isolated (ie referenced to circuit ground) input channel can be user configured as an Event, high-speed Counter or Frequency measurement input. Function specification and configuration is done in the channel's Configuration Dialog via HyperWare-II while building the Program Net. Program Net development as well as the software configuration of the GPDI channel is covered in the HyperWare-II Software Manual. Physical connection and signal interface is discussed in the following section

GPDI USER DEFINED MODES:

Event - detection of discrete or On/Off type inputs (eg logging ON time of a generator)

Count - pulse counting (eg from a flow or power meter)

Frequency - sampled frequency of an input waveform (eg from a wind speed anemometer)

EVENT APPLICATION OF THE GPDI

Event mode operation allows for the recording of the change of state of an ON/OFF or 'discrete' type input. In application within a Program Net, the input is sampled per the user defined Program Net and when a change of state is detected, the icon's output updates.

INPUT SIGNAL

Configured as an Event input, a channel will accept a powered input signal (ranging from 0 to a maximum of 30VDC) or a contact closure (dry contact) switch type input.

For powered input signals, the System Base Event function defines signals less than 0.3Vdc as a Low level and greater than 3Vdc (30VDC max) as a High level.

For contact closure type inputs, a current limited 3.3Vdc excitation "Pull-Up" voltage can be enabled via the GPDI input icon Configuration Dialog within HyperWare-II. If enabled, a 61K ohm resistor internally connects the GPDI (+) input to 3.3Vdc (Figure 3-1).

DC input resistance is greater than 60Kohm.

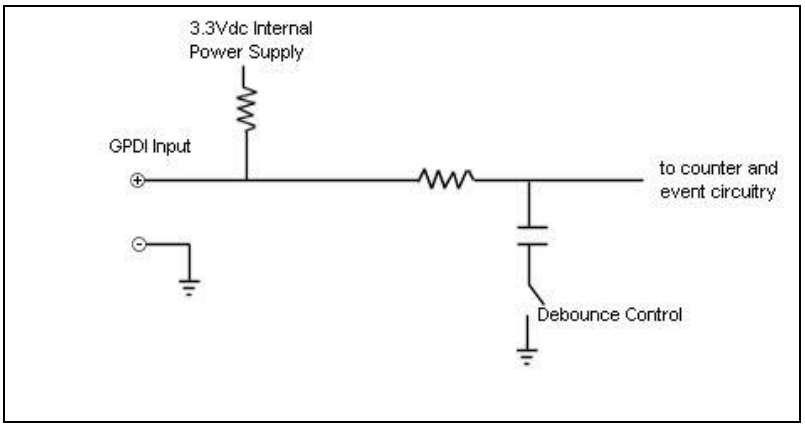

Figure 3-1; Simplified GPDI input schematic

COUNTER APPLICATION OF THE GPDI

The Counter function of the GPDI provides an accumulating total of signal transitions received at its input. This input is well suited to counting pulses from flow meters, power meters, etc.

INPUT SIGNAL

Configured as a Counter type input, a channel will accept a powered input signal ranging from 0 to a maximum of 30VDC or a contact closure (dry contact) input.

For powered input signals, the GPDI Counter function defines signals less than 0.3Vdc as a Low level and greater than 3Vdc as a High level.

For contact closure type inputs, a current limited 3.3Vdc excitation "Pull-Up" voltage can be enabled via the GPDI input icon Configuration Dialog within HyperWare-II. If enabled, a 61K ohm resistor internally connects the GPDI (+) input to 3.3Vdc (Figure 3-1).

Channel input impedance is greater than 60Kohm.

INPUT SIGNAL DEBOUNCE

When a mechanical switch is the source of the input signal, it is common that the mechanical contacts of the switch will bounce a few times upon closure until they settle into a steady closed state. The GPDI circuitry is fast enough to detect these bounces as multiple On/Off transitions and those transitions may be counted as multiple input pulses. To filter out these contact bounce induced transitions, a 40mS debounce/filter circuit can be enabled in the GPDI input icon Configuration Dialog, which filters out this contact bounce (Figure 3-1).

FREQUENCY INPUT APPLICATION OF THE GPDI

A GPDI channel configured as a Frequency type input can measure input frequencies ranging from approximately 10Hz to 20KHz. The channel will accurately measure frequencies of sine, square, or sine approximating input waveforms with peak to peak amplitudes of 100mVdc to 30Vdc. Channel input impedance is greater than 30Kohm within the specified input range.

For contact closure type inputs, a current limited 3.3Vdc excitation "Pull-Up" voltage can be enabled via the GPDI input icon Configuration Dialog within HyperWare-II. If enabled, a 61K ohm resistor internally connects the GPDI (+) input to 3.3Vdc. See Figure 3-1.

The Debounce filtering function can be enabled from within the GPDI Configuration Dialog in HyperWare-II. When used with Frequency waveform input signals, this will serve to filter high-frequency noise as well as attenuate the signal as the frequency increases. Typically the Debounce filtering is not necessary nor used with Frequency inputs however it is available for special case applications.

GPDI INPUT SIGNAL WIRING CONNECTIONS

The GPDI signal is input to the IL-Mini via terminal strip locations 5 (+) and 6(-). Note that the (-) negative terminal connects directly to IL-Mini circuit Ground.

CAUTION:

Note that a direct connection exists between the common (-) terminal and the IL-Mini circuit Ground. For this reason, ensure that Ground/Common signals supplied from different sources and connected to the IL-Mini terminal strip Ground terminal(s) are at the same potential. When multiple devices possibly powered by multiple and separate power supplies are connected to the IL-Mini, a direct connection between these Ground connections through the IL-Mini will be established.

SIGNAL WIRE SHIELDING

In most applications, use of twisted pair leads is sufficient for GPDI Event and Counter applications and the use of shielded cable for event, counter signals is not necessary due to the input circuitry noise margins.

Frequency input waveforms are amplified by the IL-Mini input circuitry. When applying low level input signals (e.g. amplitudes less than ~500mV) in electrically noisy environments, improvements in measurement quality may be seen by the use of shielded cable between the IL-Mini and the frequency source. In this case, connect the cable shield to the IL-Mini ChGnd terminal (Terminal strip terminal 1). As described in the Power and Ground wiring section, this ChGnd terminal should also be connected to a suitable earth ground to shunt any conducted voltage potential off the shield. The cable shield at the signal source end (away from the IL-Mini) should then be allowed to float (i.e. no connection made). Shielded cable use for frequency signals will also minimize cable to cable noise cross-talk to sensitive analog inputs connected to other channels of the IL-Mini.

ANALOG SIGNAL INPUT CHANNELS

The IL-Mini is provided with four programmable gain bipolar analog input channels with effective 12 bit resolution. As supplied standard, these analog channels can directly accept Vdc inputs within 8 HyperWare programmable input ranges from 20mVdc Full Scale to 2Vdc Full Scale. Time of order options expand these channels' capabilities to include direct thermocouple input, mAdc input and higher Vdc input Full Scale ranges.

The High Vdc and mAdc input ranges utilize DIP input switches to insert current shunts and attenuating circuitry into the input circuitry… eliminating the need for users to assemble external circuitry to meet today's application signal interface requirements.

Each of the channels is individually protected with fuses for over-current (typically in the mAdc mode) as well as ESD and transient protection.

Detailed labeling of the analog input channels, wiring connections and Configuration (DIP) switches are on the inside wiring panel displayed when the IL-Mini is open (Figure 3-2).

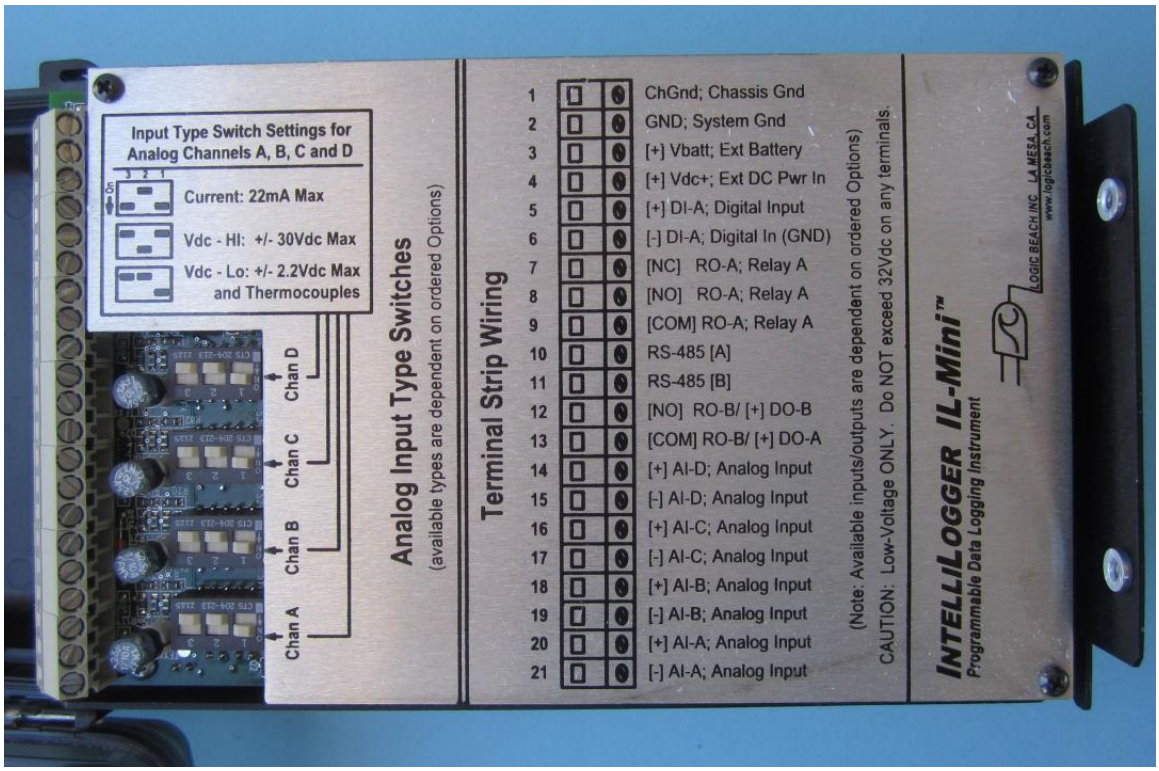

Figure 3-2; Wiring Panel with Terminal Strip Connection map

SHARED CHARACTERISTICS

All of the analog input channels and ranges share some common characteristics:

INPUT TYPE CONFIGURATION DIP SWITCHES

Each of the four analog input channels (identified as Chan A through Chan D) has a bank of 3 switches associated with it. The combination of these three switches defines the input type and/or range for that channel. These physical switches can be seen in Figure 3-4 and a simplified input schematic showing the switch functions in Figure 3-3.

The Wiring Panel indicates the Channel letter as well as the configurations for the switches to define the input type/range. The input and range options available are dependent on the time of order. Input configurations are:

- Current (mAdc)
- Vdc-Hi
- Vdc-Lo and Thermocouple

To configure a switch bank for the desired input type, use a small screwdriver or other tool and flip the three switches into the On/Off combination as shown on the Wiring Panel.

These switches modify the input circuitry for the input signal selected. Additionally, the switch settings are read by the HyperWare-II software during a Query Hardware command from within the Programming Window in order to display the correct combination of Input icons for Program Net construction.

> *Tip: As a standard practice, set the Input Type switches prior to Querying the connected IL-Mini Hardware from within the Program Net in HyperWare-II. This will insure that legitimate switch settings are set as well as provide the correct input icons to use in Program Net construction.*

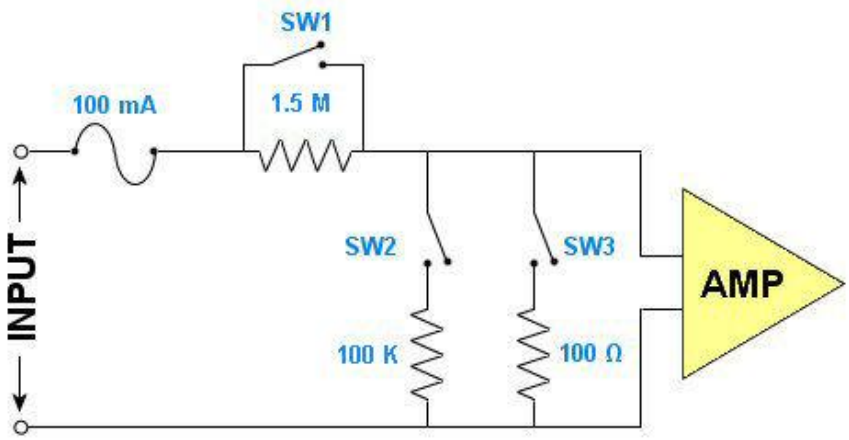

Figure 3-3; Simplified Analog Input Circuitry showing configuration switches

OVER-CURRENT PROTECTION FUSES

Each of the System Base analog inputs is protected from extreme over-current while in the current measurement mode by a series 100mA fuse. Four fuses are visible next to their associated Channel Configuration DIP switches (Figure 3-2). To replace a fuse, use your fingers or a small pair of pliers to tug the fuse straight up and out of its socket. The fuse is rated 100mA and is a Littelfuse model 273.100, which is commercially available via electronic distributors or direct from Logic Beach.

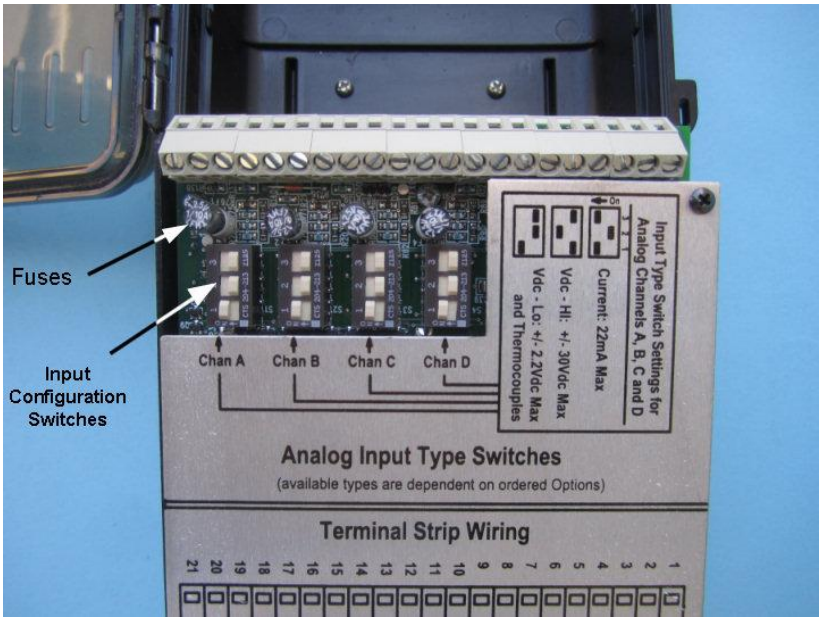

Figure 3-4; Terminal Strip and Analog Input Channels

If a channel configured as a Vdc-Lo, Vdc-Hi or more commonly a mAdc input and is unresponsive to the input signal change, the input fuse may be blown. Removal of the fuse as described above and a quick check with a resistance meter will confirm fuse condition. The fuse will measure a very low resistance (less than 1 ohm) if good or an infinite resistance (open) if blown.

Additional surge and transient protection circuitry is built into the IL-Mini power supplies and should not normally require service. The fuse is the only component that is field/user replaceable.

WIRING TERMINAL STRIP CONNECTIONS

Connections for each of the four available analog input channels are made in pairs on terminal strip locations 14 through 21. Polarity is marked on the Wiring Panel (Figure 3-2).

After securing wire connections to the terminal strips, always tug gently on the completed connection to insure that the conductor is securely clamped into the wire cage of the terminal strip.

> *Note: If installing more than one conductor into a single terminal strip location, insure that the conductors are of similar gauge (wire diameter), twist them together or solder them together before inserting into the terminal. If one conductor is larger diameter than the other and the above is not done, the smaller diameter conductor may not be clamped securely.*

COMMON MODE INPUT RANGE

The three analog inputs on the System Base are not isolated and are referenced to instrument circuit ground via a 20Kohm resistor. This circuit ground is common to other non-isolated I/O on the instrument. For this reason, all signals applied to these inputs must be within +/- 4VDC of instrument circuit ground for normal operation.

A common indication that one or more channels are out of the Common Mode input range is that the analog readings are grossly incorrect. If this is suspected, a troubleshooting method to employ is to observe the values via the IL-Mini LCD or via a connected PC. Then sequentially

disconnect each signal input to the IL-Mini, observing the readings real-time after each disconnection. If the readings suddenly become accurate, then the last disconnected channel (or a remaining single channel) may be out of the common mode range. Signal isolators, ground interconnects or other means can be used to rectify this situation.

ANALOG INPUT PROGRAM NET CONFIGURATION

The first step in building a Program Net from within HyperWare-II is to enter the Programming Window and Query the IL-Mini for its current hardware configuration. In this step, the settings of the Configuration DIP switches are read such that the appropriate icons can be returned to the workspace. *Normally, the DIP switches should be configured for each channel prior to commencing programming.*

Caution

1. Before adjusting input configuration switch settings or changing fuses, ensure that you touch the IL-Mini Wiring Panel. This will equalize the instrument and your body's electrical potential and minimize the chance of electrostatic discharge (ESD) to a sensitive component on the circuit board.

2. Use care in flipping the DIP switches to different positions so that the screwdriver does not slip and gouge the circuit board below.

VDC-LO INPUT MODE

The IL-Mini is provided standard with four analog input channels that can accept low-level Vdc input signals.

VDC-LO INPUT RANGES

Eight different input ranges are available in the Vdc-Lo mode. The range is selected on a channel by channel basis from within each Analog Input icons Configuration Dialog from within HyperWare-II. Available ranges are shown in Table 3-1.

Vdc-Lo Input Ranges
-10 to +20mV
-35 to +60mV
-45 to +80mV
-60 to +100mV
-120 to 200mV
-300 to +500mV
-0.6 to +1.0V
-1.2 to +2.0V

Table 3-1; Vdc-Lo Input Ranges

CHANNEL CONFIGURATION SWITCH SETTING

To enable a channel for Vdc-Lo input signals, the channel's Configuration DIP Switch needs to be set with Switch location 1 ON and locations 2 and 3 OFF. (for quick field reference, refer to the Switch Setting chart on the Wiring Panel, Figure 3-2).

VDC-HI INPUT MODE

The IL-Mini is optionally provided with capability to configure the four analog input channels for Vdc input signals up to 30Vdc directly.

VDC-HI INPUT RANGES

Four different input ranges are available in the Vdc-Hi mode. The range is selected on a channel by channel basis from within each Analog Input icons Configuration Dialog from within HyperWare-II. Available ranges are shown in Table 3-2

Vdc-Hi Input Ranges
-2 to +3Vdc
-4 to +7.5Vdc
-8 to +15Vdc
-15 to +30Vdc

Table 3-2; Vdc-Hi Input Ranges

CHANNEL CONFIGURATION SWITCH SETTING

To enable a channel for Vdc-Hi input signals, the channel's Configuration DIP Switch needs to be set with Switch location 2 ON and locations 1 and 3 OFF. (for quick field reference, refer to the Switch Setting chart on the Wiring Panel Figure 3-2).

This setting inserts a front end attenuation circuit into the unit allowing for the higher Vdc input signals.

THERMOCOUPLE INPUT MODE

The IL-Mini is optionally provided with thermocouple input capability for the four analog input channels.

THERMOCOUPLE TYPES AND RANGES

Seven different thermocouple types are supported in the Thermocouple Input Mode. The type is selected on a channel by channel basis from within each Analog Input icons Configuration Dialog from within HyperWare-II. Full ranges are shown in Table 3-3. Higher resolution, limited ranges are offered for some of the thermocouples and are configured within the icon Configuration Dialog.

Type	Color (USA)	Range (F)	Range (C)
J	white/red	-328 to 1832F	-200 to 1000C
K	yellow/red	-454 to 2498F	-270 to 1370C
E	purple/red	-454 to 1832F	-270 to 1000C
T	blue/red	-454 to 752F	-270 to 400C
R	black/red	-58 to 3214F	-50 to 1768C
S	black/red	-58 to 3214F	-50 to 1768C
N	Orange/red	-450 to 2370F	-270 to 1300C

Table 3-3; Thermocouple Types and Ranges

CHANNEL CONFIGURATION SWITCH SETTING

To enable a channel for thermocouple input signals, the channel's Configuration DIP Switch needs to be set with Switch location 1 ON and locations 2 and 3 OFF. (for quick field reference, refer to the Switch Setting chart on the Wiring Panel Figure 3-2).

COLD JUNCTION COMPENSATION (CJC)

The Cold Junction Compensation required for thermocouple readings is handled automatically by the IL-Mini and requires no user configuration. This Cold Junction compensating temperature is measured by a separate temperature sensor within the IL-Mini.

Note that the CJC temperature sensor also has its own CJC icon and can be utilized in a Program Net to log or alarm on the IL-Mini inside instrument temperature.

CURRENT (MADC) INPUT MODE

The IL-Mini is optionally provided with mAdc input capability for the four analog input channels.

DC CURRENT INPUT RANGES

Eight different input ranges are available in the mAdc mode. The range is selected on a channel by channel basis from within each Analog Input icons Configuration Dialog from within HyperWare-II. Available ranges are shown in Table 3-4.

DC Current Input Ranges
-100 to +200uA
-350 to +600uA
-450 to +800uA
-0.6 to +1mA
-1.2 to +2mA
-3 to +5mA
-6 to +10mA
-12 to +20mA

Table 3-4; DC Current Input Ranges

CHANNEL CONFIGURATION SWITCH SETTING

To enable a channel for mAdc input signals, the channel's Configuration DIP Switch needs to be set with Switch location 2 OFF and locations 1 and 3 ON. (for quick field reference, refer to the Switch Setting chart on the Wiring Panel Figure 3-2).

This setting inserts a 100 ohm temperature stable burden resistor across the input terminals. The voltage developed across this resistor is then proportional to the current through it.

DIGITAL OUTPUTS

One or two Digital Outputs (DO) may be provided in the IL-Mini as time of order options. The DO On/Off functions are under Program Net control and typically used to drive external Solid State Relays, LEDs or other low current, low-voltage loads.

OUTPUT CHARACTERISTICS

The DO outputs are low-current, low-voltage signal outputs. They model as a 5Vdc source in series with 200 ohms. The outputs are transient and ESD protected. At their rated 6mA full load output the voltage will be approximately 3.8Vdc (due to 1.2Vdc drop across the series 200 ohm output resistance which is calculated as follows: 5Vdc-(0.006 x 200) = 3.8Vdc).

OUTPUT WIRING CONNECTIONS

DO-A sources from the terminal strip position 13

DO-B sources from the terminal strip position 12

Utilize the Ground terminal 2 for return current (optionally share Terminal 6 which is the Digital Input Ground reference)

RELAY OUTPUTS

One or two Relay Outputs may be provided in the IL-Mini as time of order options. The Relay Outputs function under Program Net control. These outputs are typically used for driving low-voltage loads in alarming or test control applications.

OUTPUT CHARACTERISTICS

Unpowered Relay Outputs contacts are provided . As “dry” contacts, no voltage is sourced, they are simply switched contacts that can control the current flow in an external circuit. The contacts are rated for a maximum of 32 Vdc and up to 1Adc (or ac).

In applications switching inductive loads (eg relay coils, solenoids, etc) a voltage spike builds across the relay contacts when the current flow is interrupted to the inductor (ie the relay opens). This can cause excessive contact arcing and degradation as well as induced noise into surrounding circuitry. For this reason, when switching inductive loads, it is recommended that a diode, transzorb or capacitive snubber be installed across the load to clamp this induced voltage spike.

TERMINAL STRIP CONNECTIONS

Relay RO-A has Common, Normally Open and Normally Closed contacts available for load connection.

Common (COM) terminal 9

Normally Open (NO) terminal 8

Normally Closed (NC) terminal 7

Relay RO-B has Common and Normally Open contacts available.

Common (COM) terminal 13

Normally Open (NO) terminal 12

MODBUS

Modbus is a widespread industry standard serial communication protocol that allows a Modbus Master device to access memory Registers within one or more connected Modbus Slave devices. Thousands of Modbus devices exist ranging from gas analyzers to power meters to flow meters to PLC’s and more.

Two wire (half-duplex) RS-485 is used for the serial communication link between the IL-Mini and Modbus Slave(s) or a Master device. The IL-Mini can be provided with Modbus RTU Master or Slave communication capability as time of order options. Functions of the two modes follow:

- Modbus RTU Master - the IL-Mini can interrogate connected 'Slave' devices via an RS-485 connection.
- Modbus RTU Slave - the IL-Mini's Modbus registers can be interrogated by connected Modbus 'Master' devices via RS-485.

IL-MINI MODBUS OPERATIONAL MODES

Various modes of operation are provided by the IL-Mini enabled with Modbus capabilities.

IL-MINI MASTER; READ MODE

When configured with the Modbus RTU Master option, the IL-Mini garners readings from one or more connected Modbus Slave devices. The Slave device provides external access to its addressable memory Registers. In operation the Slave device periodically updates these internal Registers with values such as temperature, pressure, flow, gas concentration, On/Off states, etc.

An IL-Mini serving as a Master can then periodically read the Register values from the Slave(s) and utilize the values in the IL-Mini Program Net with the same flexibility as if they had been read from hardwired analog or digital sensors.

IL-MINI MASTER; WRITE MODE

Additionally, with the IL-Mini configured as a Modbus Master, the IL-Mini can write to Registers within a Slave device. The write operation may adjust alarm set-points, clear values, enable or disable outputs, etc within the Slave device.

IL-MINI SLAVE

When the IL-Mini is configured as a Modbus Slave, the IL-Mini allows its internal Registers to be read or written by a connected Modbus Master device. In this mode, the IL-Mini can serve as a front end data acquisition, data archiving system and share its current values with a SCADA, PLC, gas analzyer or other Modbus Master device.

IL-MINI MODBUS SETUP

HyperWare-II supports the configuration of the IL-Mini to read and write Modbus Slave registers as a Master device or operate as a Modbus Slave and share its internal Modbus Register values with a Master device. Refer to the HyperWare-II Software manual for details.

MODBUS NETWORK CONNECTIVITY

A Modbus network consists of a single Master and one or more Slave devices all interconnected in a daisy-chain configuration. The IL-Mini supports the industry standard RS-485 two-wire (half-duplex) Modbus network with cable length up to 4000ft.

RS-485 NETWORK WIRING

As shown in Figure 3-5, a Modbus network consists of a twisted pair of wires that runs from the Master to the most distant Slave device. Each Slave device on the network is connected to this backbone cable via a daisy chain configuration or via short branch leads. The two conductors are commonly denoted as A and B although industry standardization is lacking and other designations are used.

Tip: When connecting together Modbus devices with RS-485, polarity reversal is a common mistake. If communication does not work correctly, one of the troubleshooting steps to take is simple to reverse the RS-485 wiring and try again. RS-485 transceivers are fault protected from reverse connection so trial and error should not cause problems.

For RS-485 interconnection cable, simple twisted pair wire can be used in most applications. For longer runs and/or for applications in electrically noisy environments Belden 9841 cable is suggested. It has a twisted pair of 24AWG conductors, 120 ohm impedance and a shield.

If shielded wiring is used, the shield conductor should be connected to the ChGnd connection on the IL-Mini terminal strip. The shield should be left floating (ie not connected to any other devices or ground) at all other points.

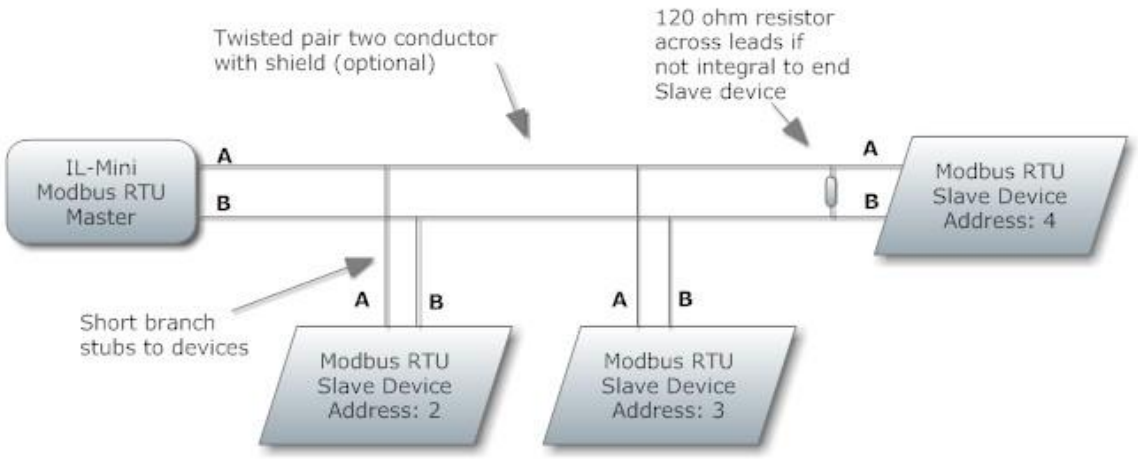

Figure 3-5; Modbus RTU RS-485 Network Wiring

RS-485 Termination Resistor

At the end of the RS-485 cable most distant from the IL-Mini, a 120 ohm terminating resistor should be connected across the A and B conductors. Many devices already have this resistor installed or enabled via a switch. If the last Slave device does not have an integral termination resistor simply wire a 120 ohm resistor across the A and B conductors at the far end. The IL-Mini has an integral 120 ohm resistor internal so a resistor should not be added at the IL-Mini location. This termination resistor serves to dampen unwanted signaling waveform reflections on the cable.

RS-485 / Modbus Terminal Strip Connection

Positions 10 (A) and 11 (B) on the IL-Mini internal terminal strip are used for the Modbus network wiring. A 120 ohm terminating resistor is installed internally across the A and B conductors so an external resistor should not be installed at the IL-Mini location.

4 USER INTERFACE

As time of order options, the IL-Mini may be equipped with front panel buttons, indicators, LCD display, USB connection. These features allow for user control of the IL-Mini as well as provide feedback from the unit such as alarm activations (LEDs) to real-time display of values and messages (LCD).

USB CONNECTION

A USB jack (USB Mini-B type) is provided on the right side of the IL-Mini front panel (Figure 4-1). The USB port is used for communication with the IL-Mini in setup as well as for viewing real-time readings from within HyperWare-II during operation.

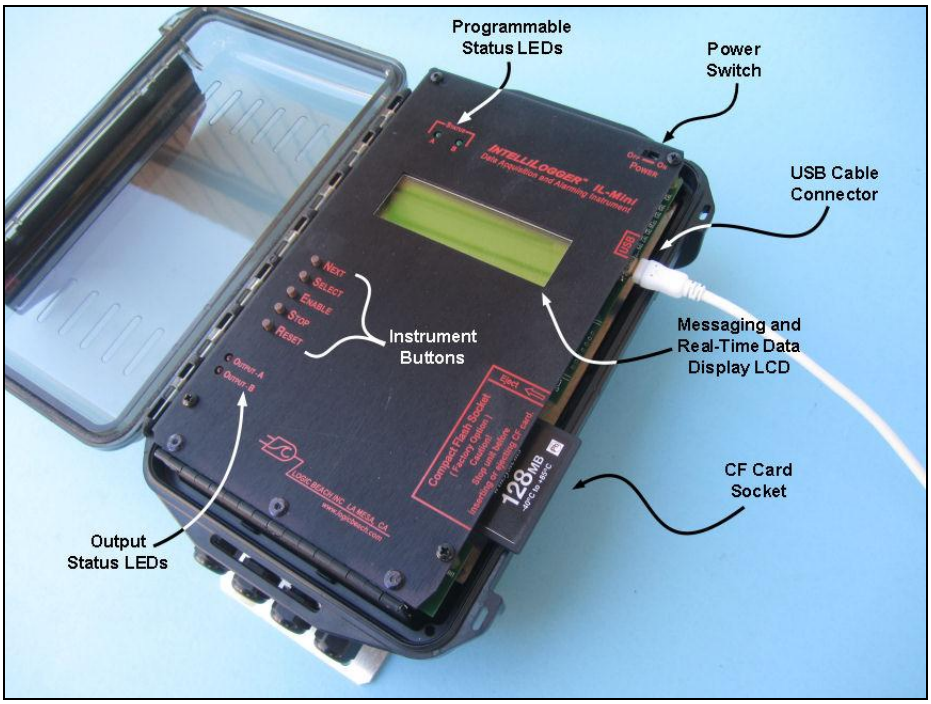

Figure 4-1; USB, CF Card and User Interface on the IL-Mini

FRONT PANEL BUTTONS

Located along the left edge of the front panel are three or five (with LCD option) momentary push buttons providing basic IL-Mini operational control. Details on the button functions follow:

NEXT AND SELECT

Provided with LCD display option. The NEXT and SELECT buttons are used for User control of the liquid crystal display (LCD) information displays. Pressing NEXT will advance the LCD display to the next menu item at the current menu level. Pressing the SELECT button selects that menu item and a new level of menus or results are displayed.

A detailed explanation of the operation of the NEXT and SELECT buttons is covered in a later section on the Liquid Crystal Display.

ENABLE

The ENABLE button initiates the execution of the current Program Net residing in IL-Mini memory. Upon pressing the ENABLE button, the LCD will display ENABLED.

FYI: *The label ENABLE was chosen rather than START for a subtle but important reason. When the ENABLE button is pressed, execution of the Program Net commences... but that does not necessarily mean that data logging to memory has started.*

For example, a Program Net is developed and uploaded to the IL-Mini that includes a setpoint function that controls logging to memory. For example log only when the kiln temperature exceeds 150F. Pressing the ENABLE button merely causes the IL-Mini to take readings of the kiln temperature... but logging to memory STARTS when the temperature rises above the 150F threshold.

STOP

Pressing STOP at any time causes the IL-Mini to finish sequencing through the currently executing Program Net, then stop executing. The LCD then updates to show STOPPED.

RESET

A hardware reset of the IL-Mini microprocessor can be performed by depressing and releasing both the STOP and RESET buttons at the same time. This normally should not be required but in the event that an extreme noise glitch or some other malfunction occurs, this manual Reset capability is provided to allow user reset of the microprocessor from the front panel.

WATCH-DOG TIMER RESET

A special automatic reset circuit is incorporated into the System Base to add additional reliability to the IL-Mini system. This circuitry, called a Watch-Dog Timer will force the IL-Mini microprocessor to reset and continue operation where it left off (within 2 seconds) in the event that an unforeseen hiccup or noise glitch (for example, from a nearby lightning strike) causes the microprocessor to lose its place or lock-up.

Although this circuit normally should not operate, it adds one more level of robustness to the IL-Mini for handling unforeseen events.

POWER SWITCH

An ON/OFF power switch is provided in the upper right corner of the IL-Mini. As with an unexpected power failure (e.g. batteries going dead), cycling the power switch off while the IL-Mini is logging will not result in a loss of data in memory. The IL-Mini circuitry detects the collapsing supply voltage and quickly closes out all data logging. Upon return of power (either due to cycling the power switch back ON or reconnection of external power, the IL-Mini will awaken, assess its status prior to the power failure and continue on. If it was logging when a power failure occurred it will commence logging.

STATUS INDICATOR LEDS

Two green LED indicators (labeled *Status*) are located at the top left corner of the IL-Mini front panel. These indicators are under Program Net control and can be programmed by the user for desired visual feedback such as temperature is in bounds, pump is on, etc.

RELAY / OUTPUT INDICATOR LEDS

Two red LED indicators (labeled Relay / Output) are located in the lower left corner of the front panel. These LEDs indicate the On/Off state of the associated output as programmed by the user within the Relay and/or Digital Output icons' Configuration Dialogs.

LIQUID CRYSTAL DISPLAY

An optional extended temperature range 4-line by 20-character liquid crystal display (LCD) is provided. Information ranging from Operational Mode to System Status to Alarm Messages to signal readings

can all be displayed on the LCD. Information to be displayed is controlled by a User via the SELECT and NEXT fronts panel buttons.

Via the HyperWare-II software the IL-Mini can be configured for various low-power modes of operation. In one of the modes, the LCD blanks after use and awakens upon a button press in order to conserve battery energy.

Alarm messages will be automatically displayed on the LCD when User pre-programmed conditions are met or when the IL-Mini detects system changes. User messages and conditions are defined by the User in the Program Net developed within HyperWare-II and loaded into IL-Mini memory.

Display Operation

Information that can be displayed on the LCD is arranged in a hierarchical format and is accessed by a User via the NEXT and the SELECT buttons on the front panel of the IL-Mini.

Pressing the NEXT button advances the display to the next available item in that menu level. Repetitive presses of the NEXT button will result in a circular sequencing through all of the available menu items on the current level and eventual repeat of the sequence.

Pressing the SELECT button selects that menu item and a new level of menus or results are displayed.

> ***TIP*** *- a basic comprehension of this LCD menu structure can be achieved by close reading of this section... but better results may be achieved by just `diving in' and poking around with the NEXT and SELECT buttons to develop a feel for the structure. .*

Basic Display Hierarchy

The following is a Listing of the LCD menu structure that can be accessed via the *Next* and *Select* buttons.

HOME MENU

When other menus are not manually selected, the Home Display is shown. Information displayed includes the Model, Firmware (internal code) version number and two lines of Operational and Status messages which indicate what tasks the IL-Mini is currently performing (e.g. Enabled, Downloading data, Stopped, etc).

From the Home Menu, tapping *Next* will advance the display through a sequence of top level menus. At any top-level menu, tapping *Select* will advance the LCD deeper into that particular branch.

From the Home Menu, pressing Next takes you to… in order…

ENTER DATA MARKER

Allows insertion of pre-defined text into the logged data file. This can be useful for noting when changes are made to the IL-Mini location, sensors, etc such as in a mobile survey application. The text messages are defined within the Program Net prior to deployment

STATUS MENU

Provides a sequence of system information displays including such items as date/time, memory status, Unit Name, supply and backup memory voltages, hardware listing, etc.

PROBE POINT VALUES

Allows for viewing (via manual selection or automatic advancement) of current 'Probe Point' values. These Probe Point values are temperatures, pressures, totals, flows, and other actual

or calculated analog and digital values that have been previously tagged within the Program Net. Refer to the Probe Point icon within Appendix A (Program Net Palette Icon Reference).

ACTIVE MESSAGES

System and conditional messages (e.g. alarms) can be reviewed within this branch. Custom messages can be developed within the Program Net to display upon events, alarms, warning conditions, etc.

CHANGE ALARM STATES

Allows front panel control of the various hardware outputs in the System Base such as relays, digital output, etc. Via the front panel and LCD, the outputs can be forced ON or OFF as well as returned to Program Net control.

ERASE LOGGED DATA

Allows for front panel erasure of data logged to internal or removable Compact Flash card memory… assuming that the currently executing Program Net has enabled this function.

CF CARD UTILITIES

Allows for front panel formatting of a non-formatted Compact Flash memory card… assuming that the Program Net has this function enabled (Global icon setting within the Program Net).

Other utilities are for possible future implementation

IL-MINI FEATURE OPTIONS

Displays a list of enabled features / options currently available in this specific IL-Mini.

5 ACCESSORIES

Various accessories and order time options are available for the IL-Mini.

CF CARD

A removable memory card option is available for the IL-Mini. A socket is available on the right hand side of the IL-Mini (Figure 4-1).

Although the socket will accept any commercially available CF card, it is HIGHLY recommended that the CF-IND-128MB CF card available from Logic Beach is used with the IL-Mini. This card has approximately 10 million data sample capacity and has tested specs including 0 Wait state memory access speeds and industrial temperature specs that have proven reliable with the IL-Mini. Consumer grade CF cards typically do not meet stringent operational specs and have been known to be unreliable in field data collection applications.

Insertion and removal of the CF card should ONLY be done when the IL-Mini has been Stopped and powered OFF. A small eject button is accessible on the right side of the socket (when viewed from the edge). Press this button and gently pull the CF card from the socket.

The CF card can only be inserted with one orientation. The card should insert easily and be seated with a final light press. If the card does not insert easily, flip it over and try again.

When the CF card is inserted in the IL-Mini, all data storage is on the CF card and the internal memory is not utilized for data storage. Details on data download from the card are covered in the *HyperWare-II Software Manual.*

PSM-4 TRANSDUCER POWER SUPPLY MODULE

The PSM-4 power supply module is available for the IL-Mini as an option. This module is integrated into the D-Cell battery pack retainer. It electrically connects to the D-cell battery pack and can be programmed to output 12, 15 or 24Vdc from the batteries. These stepped up voltages can then be used to power transducers including Vdc or 4-20mA loop powered devices.

The PSM-4 has a Control input that is normally connected to one of the IL-Mini Digital Outputs. Under Program Net control, the PSM-4 can be cycled ON to power a transducer(s) then the output signal from the transducer can be read and the PSM-4 cycled OFF. With this mode of operation, battery life can be extended. Via the Program Net, delays between power ON and the actual sampling of the output can be added to allow the transducer to "warm-up" and its output stabilize before the analog output is sampled by the IL-Mini.. Refer to the *HyperWare-II Software Manual* for futher details on programming cycled use of the PSM-4.

CONFIGURING THE PSM-4 OUTPUT VOLTAGE

The PSM-4 will take the nominal input voltage (either from a connected battery pack or and external source) and step this voltage up to 12, 15 or 24Vdc. This voltage can then be used to power one or more transducers.

The output voltage is set with two jumpers on the PSM-4 printed circuit board. The two jumpers are identified in the diagram below. Only one output voltage can be programmed in the PSM-4. Both jumpers must be set correctly to program the output voltage.

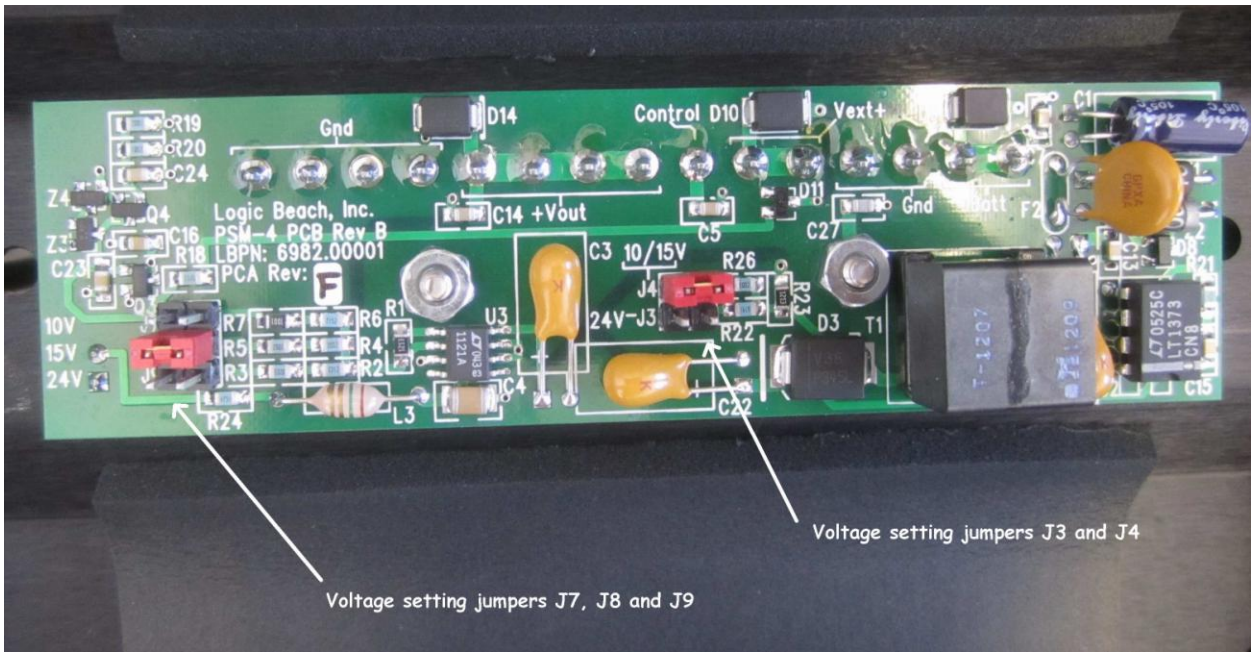

Figure 5-1; PSM-4 Printed Circuit Board showing Voltage Set Jumpers (shown set for 15Vdc Output)

Refer to the table below for correct settings for the 3 different available PSM-4 voltage outputs:

10Vdc: Install jumpers at J4 and J7
15Vdc: Install jumpers at J4 and J8
24Vdc: Install jumpers at J3 and J9

WIRING THE PSM-4

The PSM-4 can draw power from the optional six D-cell (nominal 9Vdc) battery pack if the IL-Mini is so equipped, or from an external nominal 9 to 13 Vdc supply.

Battery Pack Power Connections

As shown in the diagram below, supply voltage for the PSM-4 is provided from the battery pack wire pair connected to the PSM-4 terminal strip connections *From Batt [+]* and one of the terminals marked *GND* . The battery voltage is then relayed along to the IL-Mini power inputs via another wire pair from the PSM-4 terminal strip terminals *To +Vbatt (Mini)* and one of the *GND* terminals.

> **Note:** All terminals marked *GND* on the PSM-4 are connected together. Also, the *From Batt [+]* and the *To +Vbatt (Mini)* terminals are connected together on the PSM-4 circuit board.

Powering the PSM-4 and IL-Mini from an External Voltage Supply

The PSM-4 can be powered from an external 9 to 13Vdc supply instead of the batteries or in concert with the batteries. If both an external supply (for example a 120Vac to 12Vdc wall adapter) and the D-cell battery pack are connected to the PSM-4 and IL-Mini, if the external power should fail (for example due to a utility power outage) then the PSM-4 and IL-Mini will continue operation from the connected battery pack.

If an external nominal 12Vdc supply is connected, connect the supply to the PSM-4 terminal strip terminals marked *From Vext[+]* and *GND*. This external power can then be relayed along to power the IL-Mini by connected a lead pair from the PSM-4 terminal strip marked *ITo +Vext(Mini)* and one fo the *GND* terminals.

PSM-4 Output Cycling Control

A control signal wired from one of the IL-Mini digital outputs to the PSM-4 *Control* input can be used to cycle the PSM-4 outputs On/Off in order to save battery power. Typically, the PSM-4 is turned on to power up the transducer a short time prior to the transducer output signal being read by the IL-Mini. This results in battery power savings as the transducer is not powered continually.

A “high” voltage (nominal 3 to 16Vdc) on the Control input turns the PSM-4 outputs ON. A floating or less than 0.5Vdc Control input signal will turn the outputs OFF.

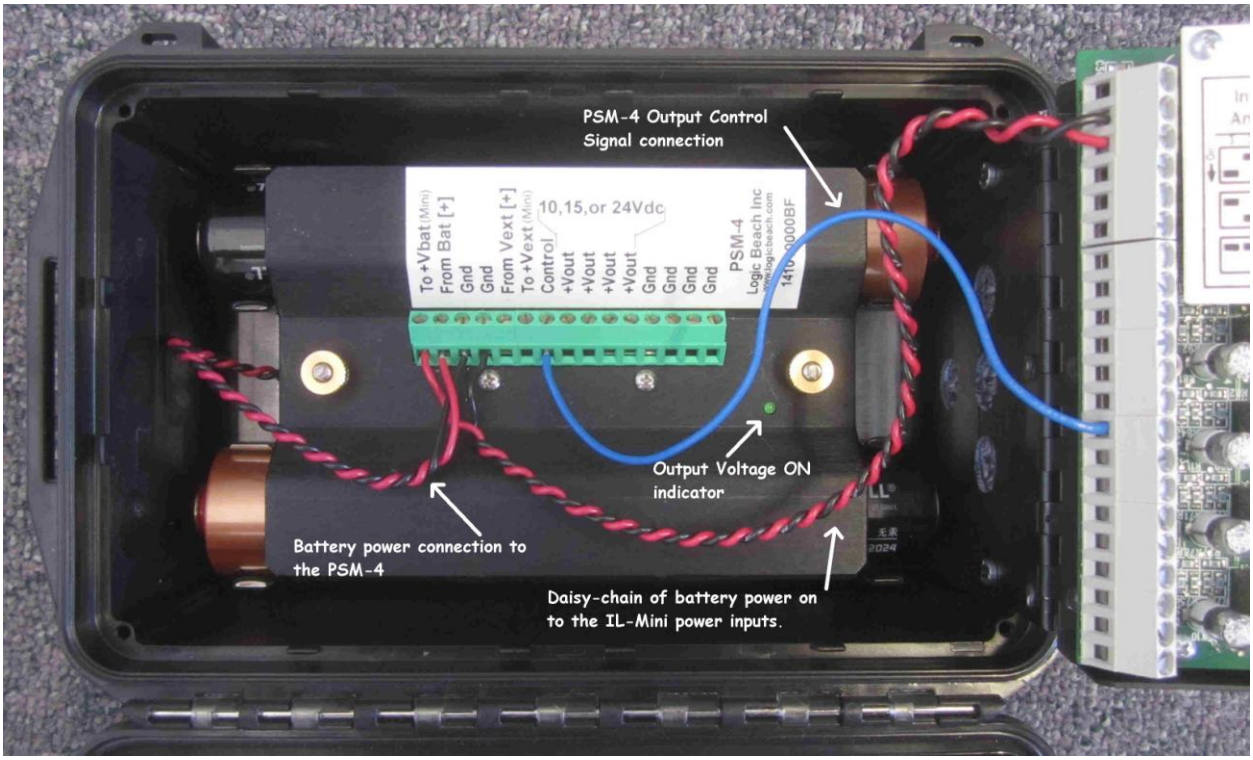

Figure 5-2; PSM-4 installed and wired for power and control

Connecting Transducers and Sensors

Any sensors to be powered from the PSM-4 can be powered from one of the four pairs of terminals marked *+Vout* and *Gnd.*

4-20mA Loop Powered Transmitters

Loop powered 2-wire 4-20mA transmitters should be wired as follows:

PSM-4 +Vout to transmitter (+) terminal

Transmitter (-) terminal to one of the IL-Mini analog inputs (configured via DIP switch for current measurement) (+) terminals.

IL-Mini analog channel (-) terminal back to one of the PSM-4 Gnd terminals.

PSM-4 Operation

The PSM-4 has an *Output Voltage ON* indicating LED on the front panel. When the output is on, the green LED will light.

6 MAINTENANCE AND TROUBLESHOOTING

LITHIUM COIN CELL

The integral Real-Time Clock in the IL-Mini as well as memory is powered from a BR2325 type lithium coin cell. In normal operation, this coin cell will operate for years without replacement. In the event that this cell discharges, a message will display in the LCD as well as in the "Status Query" response via HyperWare-II warning of a "Low Lilthium".

Also, if it is ever noted that the date/time has radically shifted by years, this could be an indicator as well. Note that the lithium coin cell is only used when the IL-Mini is not powered from an external source (D-cells or other).

To replace the coin cell:

1. Download any desired logged data and Program Net (if desired) and save to disk.
2. Power the IL-Mini OFF
3. Loosen but do not remove the four black Philips head machine screws located in each corner of the front panel. These screws are installed with thread lock so they can be fairly tight to initially break loose. Use a correct fitting screwdriver.
4. Open the unit as described in earlier sections
5. While holding the IL-Mini electronics by the Wiring Panel, finish removing the four black machine screws from the IL-Mini front panel.
6. Upon removal, the PCB will be exposed (Figure 6-1)

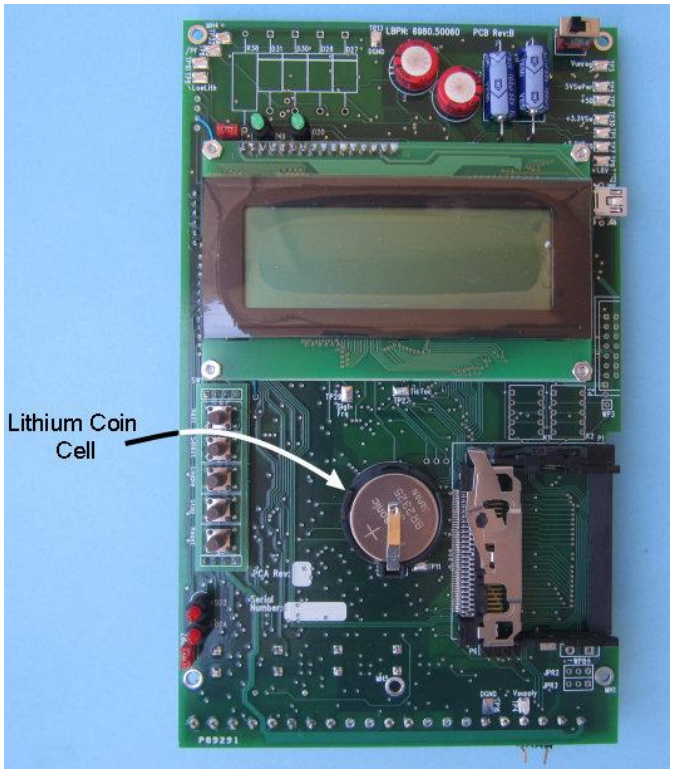

Figure 6-1; IL-Mini Printed Circuit Board (PCB) and Lithium Coin Cell

7. The coin cell is located in a plastic holder in the middle of the PCB.
8. Carefully slide the coin cell out of the holder without applying upward stress on the retaining clip. The clip is bent such that it presses down and holds the coin cell n place as well as makes contact with the top of the coin cell.
9. Discard the coin cell (do not incinerate, puncture, short or otherwise stress the coin cell as the lithium is potentially hazardous)
10. Slide in a new Panasonic BR2325 coin cell (or equivalent) with the top (positive +) face UP. These cells are available from Logic Beach as well as at most electronic shops.
11. Upon correct installation, the coin cell should drop into the recess in the battery holder and the top contact spring clip should press down securely on the top face of the coin cell.
12. Reassemble the IL-Mini PCB to the front face.
13. Power the IL-Mini and via the LCD or HyperWare-II "Status" query insure that the "Low Lithium" warning message has cleared.

STORAGE

If the IL-Mini is to be left unattended for months out of operation, the D-cell battery pack should be removed. D-cells can leak acidic electrolyte if left unattended (especially in a discharged state) for extended periods of time.

7 INDEX