# Appendix D

# Manual for Data Logger/Control Unit

## D.1. Introduction and Specifications

### *D.1.1. Q-DL-2100 Data logger Platform*

The Q-DL-2100 data logger platform consists of:

1. A microcontroller containing specialized firmware.
2. A real-time clock.
3. An analog input subsystem.
4. An analog output subsystem.
5. A digital input/output subsystem.
6. Redundant data storage, containing
    a. a user-removable SD card
    b. a non-removable Micro SD card.
7. RS-232 interfaces for communicating with PC's, sensors, or other equipment.
8. SDI-12 interfaces, typically used for communicating with environmental sensors.
9. Regulated 5V and 12V outputs.
10. Relays which can be user configured and controlled.
11. Integrated temperature, humidity and pressure sensors.
12. A Remote communications subsystem, containing
    a. an optional internal GSM or CDMA cell phone modem and/or
    b. an optional internal *Iridium* satellite modem.

### *D.1.2. Q-DL-2100 Data logger Options*

The Base Model Number of the Q-DL-2100 units is:

Q-DL-2100

Several remote communications options are available:

| | |
|---|---|
| -G | GPRS (GSM) Integrated Cell Phone Modem. |
| -C | CDMA Integrated Cell Phone Modem |
| - I | Integrated *Iridium* Satellite Modem |

| | |
|---|---|
| **Note 1** | The Q-DL-2100 may contain both a cell phone modem and an *Iridium* modem. i.e., a Q-DL-2100-GI model number would indicate the unit contains both an integrated GSM modem and an integrated *Iridium* modem, whereas a Q-DL-2100-I would indicate the unit contains only an integrated *Iridium* modem. |

| **Note 2** | An integrated cell phone modem, *Iridium* modem, or both can be added to the data logger at any time. Contact Quaesta Instruments LLC for pricing and details. |
|---|---|

### *D.1.3. Q-DL-2100 Data logger Specifications*

- **Microcontroller based.**
- **Program Execution Rate:**
  - 1 min to 1 yr, in 1 minute increments.
- **Analog Inputs**:
  - 4 Single-Ended inputs.
  - 0 to 5V range.
  - 2.5 $\mu$ V resolution (21 bits).
  - Integrated 50Hz or 60Hz noise suppression (factory settable).
  - Conversion time for single channel measurement:
    - ~130 ms for 60 Hz suppression.
    - ~150 ms for 50 Hz suppression.
  - Aggregrate Attainable ADC Data Rate:
    - 5 Hz.
- **Analog Outputs**:
  - 4 independent 16 bit DAC outputs.
  - 0 to 5V range.
  - ~ 0.08 mV resolution.
- **Digital I/O Ports**:
  - 4, each individually configurable as TTL input, TTL output, or TTL counter.
- **Relays**:
  - 4 solid-state, each rated for 30 Volts DC @ 1.2Amps.
- **Relative Humidity Sensor with Temp**
  - 1 integrated,
    - RH Resolution = 0.05%.
    - RH Accuracy ~ 3% over the 20% to 80% RH range.
    - Temp Resolution ~ 0.5 deg C.
    - Temp Accuracy ~ 1 deg.
  - 1 external , characteristics as internal.
- **Temperature Sensor**:
  - 1 integrated,
    - Range -55 C to + 125 C.
    - Resolution = 0.35 deg C.
    - Accuracy = 0.5 deg C (from -10C to +85C).
  - Multiple external, up to 16 sensors.
- **Barometric Pressure Sensor**
  - 1 Integrated, with hose barb connection for external pressure monitoring.
    - 0.1 mbar resolution.
  - Calibratable with simple offset pressure calibration number.
- **Switched Regulated Power Outputs**
  - 5 V.
  - 12V.
- **Real-Time Clock**
  - Clock Accuracy: 3 min per year.

    - May be automatically updated via satellite if *Iridium* satellite remote telemetry option is chosen.
- **Sensor Communications Support**
  - RS-232, 2 Ports.
  - SDI-12, 2 Ports,Up to 10 SDI sensors per port.
- **Remote Telemetry Support**
  - Integrated *Iridium* Satellite Modem (-I option).
  - Integrated Cell Modem -GPRS (-G option) or CDMA (-C option) capable.
  - Data logger can respond to remote commands sent via simple email in the case of *Iridium* service and simple text messages in the case of Cell Phone modem service.
- **Data Storage**
  - 1 user removable SD card.
  - 1 non-removable Micro SD card, for redundant data storage.
- **Power Requirements**
  - Voltage: 6 to 26 V DC.

  *Note*: Voltage greater than 12.3 V required to use fully regulated 12V output.
  - Typical Current Drain:

    Idle Mode: ~ 10 mA .

    *Note 1*: 7 mA is quiescent current of Integrated pressure sensor.

    *Note 2*: Can be powered from 12V or 24V solar panels.
- **Data logger Configuration**
  - Via simple to use QILogger.INI text file on external SD card.
  - Via USB or RS232 port and terminal program such as *Windows HyperTerminal* or Teraterm.
  - Via PC based software with RS232 communications control.

  *Note:* GUI driven PC-based software can be obtained from Quaesta Instruments.
- **Physical Specifications**
  - Dimensions: 7 ½ in. x 6 ¾ in. x 2 ¼ in.
  - Rugged extruded aluminum housing.
- **Additional Features:**
  - Input Power is monitored and optionally recorded if desired.
  - Power Conservation modes. Can be easily configured to enter power saving mode when:
    - Input Power Voltage level drops below a user-settable threshold.
    - Daily power down time occurs (will then leave power saving mode when Daily Power Up time occurs).
- **Neutron Pulse Module (Q-NPM-1000) support**
  - The Q-NPM-1000 is a Quaesta Instruments neutron pulse module designed to interface directly with neutron counting tubes.
  - Multiple Q-NPM-1000 modules may be connected to a Q-DL-2100 data logger, allowing for completely autonomous and unattended Neutron counting and logging.

### *D.1.4. Q-DL-2100 Data logger Front Panel Layout*


**Figure D-1.**

**Power Input:**

2.5 X 5.7MM barrel type power jack. Nominal 12V required. 6 - 26 V DC is allowed. A voltage greater than 12.3 VDC must be utilized to enable a fully regulated 12V DC output (5V and 12V regulated power outputs are available from the back panel).

**On/Off :**

Power may be toggled with the On/Off Switch

**LEDs:**

P: Heartbeat LED. Flashes at a nominal cadence of once every 8 seconds while idle, once every second while not idle.

Q: Data Acquistion indicator LED. Illuminates during data acquisition and data storage process.

**SDI12 Interface Connectors:**

Two jacks, labeled A and B, are provided.
Standard three-wire stereo jacks are employed.

**SD/MMC:**

Standard SD card slot, Push In/Push Out type socket.

**Com:**

Terminal type Communication via USB is supported (with appropriate PC drivers).

### *D.1.5. Q-DL-2100 Data logger Back Panel Layout*

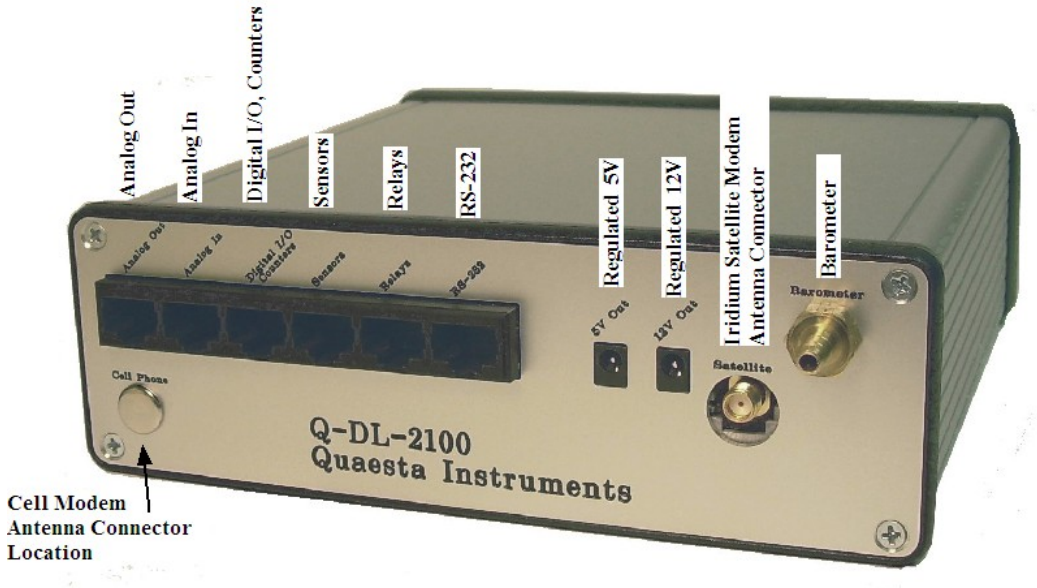



**Figure D-2.**

**RJ-45 Connectors**

Utilized for the Analog Out, Analog In, Digital I/O and Sensor subsystems as well as for Relays and RS-232 interfaces. Standard Ethernet cable and connectors may be used.

**Regulated 5V Output**

1.0 X 4.2 mm barrel type power jack. The 5V regulated output may be turned ON/OFF via the appropriate data logger INI parameter.

**Regulated 12V Output**

1.3 X 4.2 mm barrel type power jack. Note that 12.3V DC or greater must be supplied to the data logger Power input to enable the full 12V regulated power output. The 12V regulated output may be turned ON/OFF via the appropriate data logger INI parameter.

**Iridium Satellite Modem Antenna Connection**

For data loggers with an integrated *Iridium* satellite modem, a standard SMA female connector is present for connecting a user supplied *Iridium* antenna. Quaesta Instruments can provide the antenna and cable or suggest an appropriate supplier. Contact Quaesta Instruments for pricing and details.

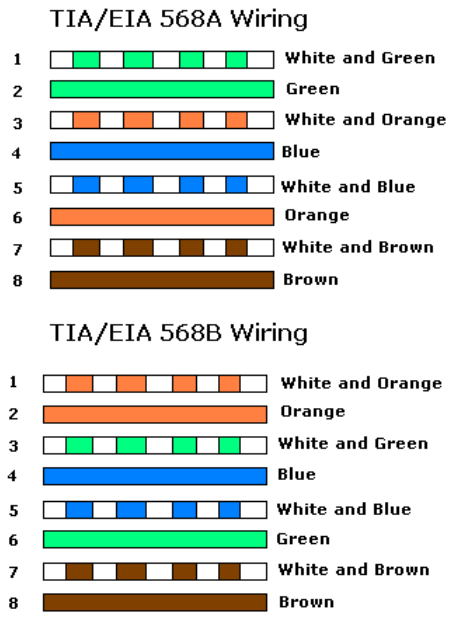
**Barometer**

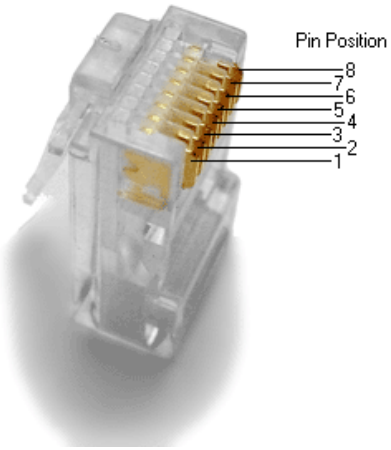
An integrated barometer is present. A hose barb allows for pressure monitoring at some distance from the data logger.

### *D.1.6. Q-DL-2100 Electrical Connections: Back Panel*

RJ45 modular 8 pin, 8 conductor Jacks are located on the Back Panel for the Analog Out, Analog In, and Digital I/O subsystems as well as the Sensors, Relays, and RS-232 interface connectors. Standard ethernet patch cable with an RJ45 modular 8 pin, 8 conductor Plug may be used. The cable jacket and individual wire insulation may be easily stripped at the other end to facilitate connections to other equipment. As many different grades of ethernet cable are available, it is recommended that good solid conductor ethernet cable is utilized for reliability in the field. The solid conductor cable is also easier to strip than the stranded conductor type.

Patch cable with EIA/TIA 568A and EIA/TIA 568B type connections are available. The more commonly available today is patch cable made with EIA/TIA 568B type connections. For the user's convenience, diagrams for each of these standards is included below as well as the pin positions for the RJ45 plug.



Below is a table of pinouts for the RJ45 connectors on the back panel and the corresponding wire colors for an EIA/TIA 568B type patch cable. Appropriate changes should be made if an EIA/TIA 568A type patch cable is used instead.

**Table D-1. RJ45 Connector wiring diagram for EIA/TIA 568B type patch cable.**

| | | |
|---|---|---|
| **ANALOG OUT** | | |
| 1A | Ground | Orange/White |
| 2A | AnalogOut-1 | Orange |
| 3A | Ground | Green/White |
| 4A | AnalogOut-2 | Blue |
| 5A | Ground | Blue/White |
| 6A | AnalogOut-3 | Green |
| 7A | Ground | Brown/White |
| 8A | AnalogOut-4 | Brown |
| **ANALOG IN** | ***Note*: 5 Volts Maximum** | |
| 1B | Ground | Orange/White |
| 2B | AnalogIn-1 | Orange |
| 3B | Ground | Green/White |
| 4B | AnalogIn-2 | Blue |
| 5B | Ground | Blue/White |
| 6B | AnalogIn-3 | Green |
| 7B | Ground | Brown/White |
| 8B | AnalogIn-4 | Brown |
| **DIGITAL I/O** | | |
| 1C | Ground | Orange/White |
| 2C | DigitalI/O-1 | Orange |
| 3C | Ground | Green/White |
| 4C | DigitalI/O-2 | Blue |
| 5C | Ground | Blue/White |
| 6C | DigitalI/O-3 | Green |
| 7C | Ground | Brown/White |
| 8C | DigitalI/O-4 | Brown |
| **SENSORS** | | |
| 1D | Ground | Orange/White |
| 2D | 5 Volts | Orange |
| 3D | Ground | Green/White |
| 4D | External Temp Sensor | Blue |
| 5D | Ground | Blue/White |
| 6D | Humidity Sensor Clock | Green |
| 7D | Ground | Brown/White |
| 8D | Humidity Sensor Data | Brown |
| **RELAYS** | ***Note*: 30V, 1.2A Maximum** | |
| 1E | RelayB-1 | Orange/White |
| 2E | RelayA-1 | Orange |
| 3E | RelayB-3 | Green/White |
| 4E | RelayA-2 | Blue |
| 5E | RelayB-2 | Blue/White |
| 6E | RelayA-3 | Green |
| 7E | RelayB-4 | Brown/White |
| 8E | RelayA-4 | Brown |
| **RS-232** | ***Note*: TX and RX are with respect to the data logger** | |
| 1F | Ground | Orange/White |
| 2F | TX - A | Orange |
| 3F | Ground | Green/White |
| 4F | RX - A | Blue |
| 5F | Ground | Blue/White |
| 6F | TX - B | Green |
| 7F | Ground | Brown/White |
| 8F | RX - B | Brown |

## D.2. Data Logger Operation

### *D.2.1. Installation*

To install the Q-DL-2100 data logger unpack the data logger and follow these steps:

1. Configure the QILogger.INI located on the external SD card as appropriate and as described in detail in Section 2.2 below. This file can be edited via a simple word processor such as Wordpad or Notepad on a Microsoft *Windows* based PC.
2. Provide power to the data logger via the Power Jack on the front panel. One may utilize nominal 12V DC power supplied from an AC adapter or from a battery source.
3. Switch on the data logger. The data logger's heartbeat LED should first flash at a cadence of several flashes per second for nominally 5 seconds. Then the data logger firmware will configure the data logger using INI parameters as found in the QILogger.INI file located on the external SD card. Next, the data logger will execute a self test of the data acquisition system, after which time the heartbeat LED will begin flashing at a cadence of approximately once every 8 seconds.

### *D.2.2. Data Logger Configuration*

The Q-DL-2100 data logger is configured for operation via a set of simple INI parameters.

At power on, the data logger attempts to read and load these parameter settings from a QILogger.INI text file located on the external SD card. If the QILogger.INI file is present then parameter settings are obtained from the file and the file is copied to the internal SD card. If the QILogger.INI file is not present on the external SD card, then the data logger will attempt to read and load parameter settings from the current version of the QILogger.INI text file located on the internal SD card. If no QILogger.INI file is found on either the external or internal SD cards, then the data logger will utilize default values for the INI parameters.

**See Section 5.1.2 for a list of INI parameters.**

The data logger's INI parameters may be changed or edited by one of the following methods:

1. Via direct editing of the INI parameter fields in the QILogger.INI text file located on the removable SD card.
2. By setting of the INI parameter fields through a simple Terminal interface program such as *Windows HyperTerminal* or *Tera Term Pro*.
3. By remote telemetry, via email or text message depending on the telemetry option.