1. Specifications:
   - 1 to 4 analog input channels, 0 to +5 v input range
   - Provisions for input voltage limitation
   - Provisions for input voltage offset up to 5 v
   - Manual, external and timed trigger modes
   - Timed trigger intervals from 1 second to 9999 minutes
   - Data storage on Secure Digital (SD) memory card (FAT16 format)
   - Selectable plain text or comma-separated variable (CSV) file formats
   - Up to 65,000 samples per data file
   - Up to 9999 files per SD card
   - PIC18F452 microcontroller operating at 20 MHz
   - 10-bit analog-to-digital converter (ADC) with resolution of 1 part in 1024
   - Firmware written in C and compiled with MikroC (source code available)
   - PCF8583 real-time clock/calendar with battery backup
   - 4-line x 16-character liquid crystal display (LCD) with backlight
   - EIA-232 serial port (for firmware programming)
   - 12 – 18 v dc input voltage range
   - 25 – 80 ma input current range

2. Firmware:
   This User Guide is based on V2 firmware. V2 added some additional functions as well as a backlight timer (hardware modifications are required to use this function). The datalogger has an EIA-232 serial port that only is used to program the firmware. It presently has no other application.

3. Secure Digital Memory Cards:
   SD cards must be formatted on a PC in FAT16 mode before being used in the datalogger, and the SD card must be installed in the datalogger before applying power. If this is not done, the following message is displayed:

   ```
   INIT SDCARD FAIL
   ```

   Some users have had problems using various SD cards – the data logger does not recognize a properly formatted card and displays this message when power is applied:

   ```
   INIT SDCARD FAIL
   SYSTEM STOPPED
   ```

4. Channels:
   The datalogger can record up to four simultaneous channels, each with an input of 0...5 v dc corresponding to the decimal range 0000...1023 (10-bit binary). Channel numbers are 0, 1, 2 and 3.

   To convert the recorded decimal value to voltage, multiply the recorded value by 5/1023. The files can be recorded in .txt or .csv formats; all channels are recorded in the same format as shown below. Files are automatically named in a 4-digit format, for example, 0123.txt or 0123.csv.

The value being measured is displayed for each channel on the bottom-right of the display:
Ch. 1        Ch.2
Ch. 3        Ch. 4

Example:
```
DATE: 10/12/2009
TIME:   19:29:07
        0000 0021
0       0118 0321
```

All four channels are displayed even though only 1, 2 or 3 channels are being recorded. The displayed values represent the actual voltages at the channel inputs. If the input is open-circuited (no external voltage source connected to it), the displayed value seems to be the internal offset voltage and is not zero. If the unused channels are short-circuited, the reading will be 0000.

The display also shows the sample number on the bottom-left of the display. The sample number starts counting as soon as the datalogger is triggered. Each file can store 65,000 samples. Immediately above the sample number is a decrementing value showing the number of seconds or minutes left before the next sample is taken.
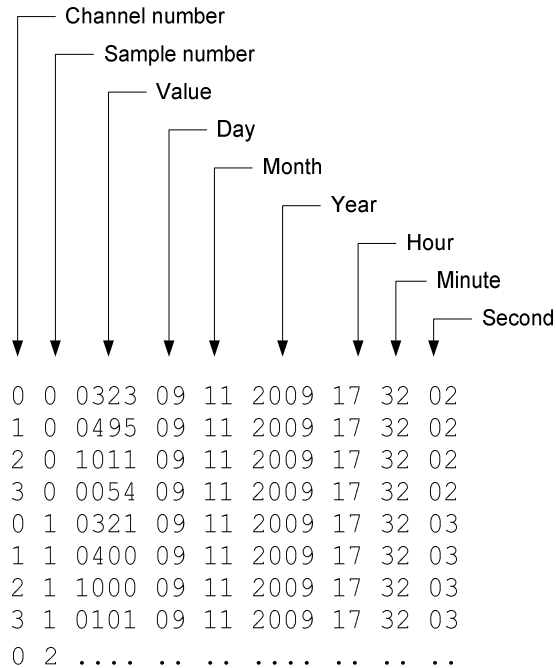
5.  File formats:

Text file format:

Format:
Channel number  Sample number  Value  Day  Month  Year  Hour  Minute  Second

Example (4 channels):

```
        ┌── Channel number
        │      ┌── Sample number
        │      │      ┌── Value
        │      │      │      ┌── Day
        │      │      │      │      ┌── Month
        │      │      │      │      │      ┌── Year
        │      │      │      │      │      │      ┌── Hour
        │      │      │      │      │      │      │   ┌── Minute
        │      │      │      │      │      │      │   │   ┌── Second
        ▼      ▼      ▼      ▼      ▼      ▼      ▼   ▼   ▼

        0  0  0323  09  11  2009  17  32  02
        1  0  0495  09  11  2009  17  32  02
        2  0  1011  09  11  2009  17  32  02
        3  0  0054  09  11  2009  17  32  02
        0  1  0321  09  11  2009  17  32  03
        1  1  0400  09  11  2009  17  32  03
        2  1  1000  09  11  2009  17  32  03
        3  1  0101  09  11  2009  17  32  03
        0  2  ....  ..  ..  ....  ..  ..  ..
```
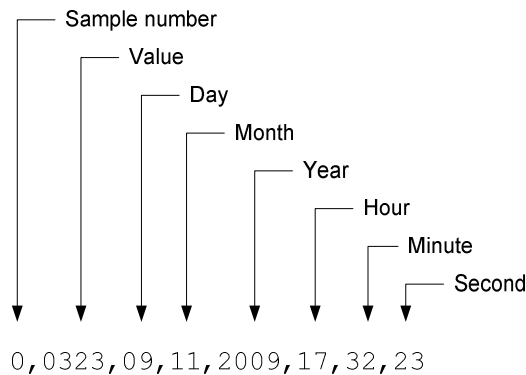
Comma Separated Variables file format:

Format:
Sample number,Value,Day,Month,Year,Hour,Minute,Second

Example (1 channel)

```
              ┌── Sample number
              │      ┌── Value
              │      │      ┌── Day
              │      │      │      ┌── Month
              │      │      │      │      ┌── Year
              │      │      │      │      │      ┌── Hour
              │      │      │      │      │      │   ┌── Minute
              │      │      │      │      │      │   │   ┌── Second
              ▼      ▼      ▼      ▼      ▼      ▼   ▼   ▼

              0,0323,09,11,2009,17,32,23
:
```

6.  <u>Control Switch Functions</u>:
    The first thing to notice is that the pushbutton controls switches, S1, S2 and S3, as mounted
    on the PCB are in reverse order with  S3 on the left and S1 on the right. If the EDL PCB is
    installed in an enclosure, the switches should be installed in the normal order (left-to-right).

    <u>S1</u>: Selects the operating mode and is used to adjust the date and time. To set date and time,
    press S1 while turning on the power. When text `SD Card OK` appears, release the switch.
    Use S2 and S3 to increment and decrement, respectively, the date and time fields. Use S1 to
    move to the next field in the following sequence:

    Day→Month→Year→Hour→Minute→Second

When finished setting each field, press S1 once more to set the clock. To set to the nearest second, adjust the Second to the desired value ahead of the actual time. When that time is reached, press S1. The datalogger then goes into operation. US users should note the reversed day and month fields.

The datalogger has several operating modes, which are selected by S1:
- External trigger, TB-3 input, triggers when the preset threshold is reached
- Manual trigger, triggers when S2 is pressed (called "on-the-fly" trigger)
- Internal trigger, 10 second intervals
- Internal trigger, 60 second intervals
- Internal trigger, 0000-9999 seconds or 0000-9999 minute intervals, programmable
- Trigger when maximum reached, triggers when channel 1 reaches value = 1023

The above selections are displayed in the following order each time S1 is pressed:
1. EXTERNAL TRIGGER (apply 5 v to TB-3 to save)
2. SAVE ON KEYPRESS (press S2 to save)
3. SAVE EVERY 10 S (datalogger is saving when displayed)
4. SAVE EVERY 60 S (datalogger is saving when displayed)
5. INTERVAL: 0001 S or M (datalogger is saving when displayed, see Note 1)
6. SAVE ON MAXIMUM (datalogger saves when channel 1 reaches value = 1023)
7. CHANNELS: 1 or 2 or 3 or 4 (select number of channels with S2)
8. SHOW DETAILS: Y or N (select with S2, see Note 2)
9. CSV FILE: Y or N (select with S2)

Note 1: Use S1 to select this mode. Press S2 to select the first digit and press S2 and S3 to increment and decrement the first digit. Press S1 to move to the next digit and press S2 and S3 to increment and decrement the next digit. Repeat until all four digits are set to the desired value. Press S1 to move to the seconds/minute field and press S2 or S3 to toggle between S and M. When all done, press S1 to start recording.

Note 2: This function appears to do nothing

When the desired trigger mode is displayed, no other action is required. The datalogger immediately starts logging according the specified trigger.

S2: Triggers the datalogger (when datalogger is set to manual trigger mode), selects the number of channels when S1 is set to Channels, and selects CSV or TXT file formats. When the datalogger is in the date-time setting mode, S2 is used to increment the field values.

S3: Selects a new recording file when the datalogger is set to the desired trigger mode. Each time S3 is pressed, a new file is started. This can be somewhat frustrating because accidentally bumping the switch will start a new file. There is no way to back up to use a previous file. When the datalogger is in the date-time setting mode, S3 is used to decrement the field values.

7. Other functions:
   JP1 applies +5 v to channel 4 (AN3 on TB-3) as an offset for channel 1 (AN0 on TB-7).

8.  <u>Bootloader settings</u>:
    Speed: 57,600 b/s
    1 stop
    8 bits
    No parity
    Software flow control

9.  <u>Power requirements</u>:
    Input voltage: 9-15 v dc
    Input current (measured with 12.6 v input voltage):
    While setting time: 79 ma
    Running, backlight on: 57 ma
    Running, backlight off: 26 ma

10. <u>Material required to install the datalogger PCB in an enclosure</u>:
    (3) Action Electronics p/n 30-040B or p/n 35-400 pushbutton switch
    (1) Hammond Mfg. p/n 1591ETCL clear polycarbonate enclosure
    (1) Action Electronics p/n 504KB, 3.5 mm panel-mount stereo phone jack
    (1) Phoenix Contact p/n 1827596, 8-position pluggable terminal block, feed-through
    (1) Phoenix Contact p/n 1827761 or p/n 1827033, 8-position plug
    (1) Mountain Switch p/n 108-0001-EVX, SPST miniature toggle switch
    (1) Kobiconn p/n 163-4302-E, 2.1x5.5 mm coaxial dc power jack, panel mounted
    (4) Keystone Electronics p/n 877, 0.375 in. x No. 4 plastic spacer
    (4) Keystone Electronics p/n 3358, No. 4 x 0.062 in. nylon washer
    (2) Keystone Electronics p/n 4805K, 0.875 in. x 4-40 threaded nylon spacer, male-female
    (4) Keystone Electronics p/n 0.375 in. x 4-40 threaded nylon spacer, female-female
    (2) Keystone Electronics p/n 4-40 nylon hex nut
    (6) B&F Fastener Supply p/n PMS 440 0031 PH, 4-40 x 0.3125 in. pan-head machine screw
    (4) B&F Fastener Supply p/n PMS 440 0075 PH, 4-40 x 0.75 in. pan-head machine screw
    (1) Powersonic p/n PS-1208, 12 v, 800 mah sealed lead-acid battery
    (1) Amp Mate-N-Lok p/n 1-480319-0, 2-pole, free-hanging pin housing
    (2) Amp-Tyco p/n 60618-1, pin contact
    (1) Bussmann p/n BK/HHT inline fuse holder for 5x20 mm fuse
    (1) Littelfuse p/n type 213, 5x20 mm time-lag fuse, 2.5 or 3.0 a
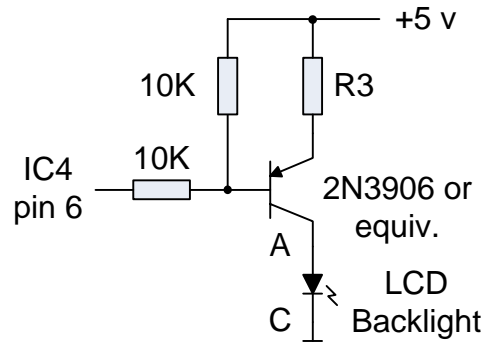    (1) lot 24 AWG stranded hookup wire, various colors
    (1) NTE p/n 3130, blinking LED, yellow
    (2) NPN, 10k ohm, 1/4 w resistor
    (1) NPN, 2N3906 (or equivalent), PNP, 200 ma switching transistor

    Note: To decrease power consumption, modify the LCD backlight wiring as shown below, install version 2 firmware and replace the stock power-on LED with a blinking LED.

+5 v

10K   R3

IC4     10K
pin 6

2N3906 or
equiv.

A

LCD
C   Backlight