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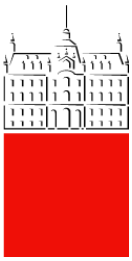


Datalogger DL844 User's manual

Draft, April 2010

Introduction

The datalogger can read up to 8 analog voltages and 4 digital channels and store data to an SD card or output it to RS-485 port. 4 current sources are provided to bias sensors connected to the datalogger. Data can be time-stamped with internal battery-backed clock. The FAT formatted card can also be read from RS-485, (RS-232) or USB port. Configuration can be stored on the card or transferred through RS-485. Various supply options are available including internal rechargeable battery.

Specifications in this manual are preliminary and are subject to change without prior notice.

Local user interface

Buttons

RST	Holding this button at power on will reset RS-485 address to 53 (decimal) and clock to 2000-01-01 0:00:00. The button can be also used to clear a run-time error, i.e. turn off error LED.
START	Pressing the button will start or stop logging process.
PWR	Pressing the button will power on/off the datalogger.

LEDs

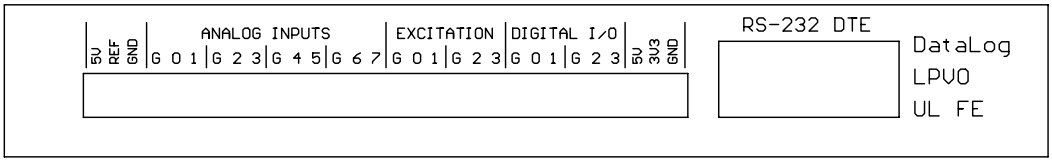
PWR (green)	Signals that the datalogger is powered. Blinks when it is running on batteries and is solid when on external power.
BAT (yellow)	Blinks when the main battery is low.
USB (red)	Lights when the datalogger is connected to USB an enumerated. Logging process cannot be started when this LED is lit.
SAMP (green)	Lights when sample is being taken.
LOG (yellow)	Lights when logging is active or when data is transferred over USB.
ERR (red)	Signals error with one long blink and certain number of short blinks (see table below). Blinking is continued while logging is active. In that case blinking can be stopped by pressing the RST key.

At power on logging is not active. Logging can only be started when an SD card is inserted and USB cable is not connected. When logging is started, configuration file on the card will be parsed and logging will begin. Logging is normally stopped with key or remote command, but will also be stopped when USB cable is plugged in and USB enumerated, memory card is filled-up and battery is empty. Logging is also stopped when the power button is pressed.
The datalogger will be automatically turned of when battery is empty. Note that when the datalogger is connected to USB it is still powered from battery unless external power is applied.

Blinks	**Error**
1	No memory card was detected.
2	The card is full.
3	Other card error.
4	The card is write-protected.
5	No configuration file was found.
6	Error parsing configuration file.
7	1-wire error. No sensor was found on one of specified channels or a sensor can not be read.

Connections

Front panel



Connection of measurement signals to the datalogger is accomplished by 3-pole modular plug connectors. The pinouts of all connectors are visible from the image above. G and GND stands for ground connection. Ground is common to all connections, however, analog and digital ground should not be mixed.

5V, REF, GND

Power supply output. 5 V is filtered supply and present only when bias is present. REF is reference voltage output and is not intended for supply of power hungry external circuits. GND is analog ground.

ANALOG INPUTS

Inputs for analog signals. Input range depends upon configuration. Differential signals should be defined, not floating. G is analog ground.

EXCITATION

These pins output constant current if voltage on them is within certain limits. G is analog ground.

DIGITAL I/O

These pins go to CMOS 3.3 V logic through protection circuits. G is digital ground.

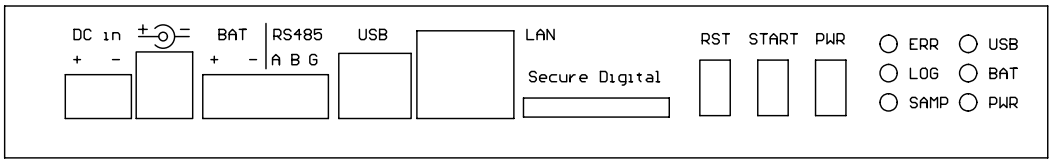
5V, 3V3, GND

Power supply output. 5 V is present only when bias is present. 3V3 is always present, even when the datalogger is turned off. 5V output can be used as an enable signal to draw higher current from 3V3 pin. G is digital ground.

RS-232

RS-232 interface has DTE pinout and can be used to monitor output data. Data will be output in the same format as to the file.

Back panel



DC in
These are connectors for external supply voltage. Both of the connectors are in parallel. Ground is the same as for other connections including front panel connections.
BAT
This connector is intended for external battery and is connected in parallel to internal battery. It is output of power supply that receives power from DC-in connectors. All the circuitry is powered from this supply.
RS485
Connection for RS-485 bus. Using internal jumpers termination and pull-up resistors can be enabled. Datalogger is a slave in master-slave configuration.
USB
USB B-type receptacle for connection to a USB host. The datalogger acts as a Standard Mass Storage Device to access the Secure Digital card.
LAN
8P8C socket for connection to 100BASE-TX or 10BASE-T network.
Secure Digital
Socket for a Secure Digital memory card. The card should be inserted face-up, that is with pins facing down.

Configuration file syntax

Configuration file must be named config.txt and is loaded and interpreted at beginning of logging operation. Data will be output to a new file named log_NNNN.txt. The 4-digit number will be one more than the highest already existing number. If the highest existing number is 9999, search for free number will begin with 0001. If none is found, data will be appended to file named output.txt. Each sample is in new line, whereas channels are separated with semicolon. Buffered data is flushed to the card every 10 minutes to prevent loss of data.

General configuration

Each parameter is given in a separate line.
PER <value> [min | hr]
Sample period. Default value is 1 minute. Default unit is second.

Channel configuration

Each channel configuration is given in a separate line. Order of parameters is not important, however FRMT must be the last one.
[<function>@] <channel> [GAIN <gain>] [BUFF (ON | OFF)] [MATH <k> [<n>]] [FRMT <format string>]

functions

VOLT	Measure voltage. Default for analog channels.
BIT	Bit(s) value. Default for digital channels.
PTx	Convert value for Platinum RTDs. Input value of 1 V represents 0 °C. Algorithm (3^{rd}/4^{th} order polynomial) is applied after math.
TCK	Convert value for K-type thermocouple. Input values are in volts. Algorithm (9^{th}/8^{th} order polynomial) is applied after math.
TEMP	Measure temperature of 1-wire sensors on a digital channel.
TIME	Time in the format hh:mm:ss.
DATE	Date in the ISO format YYYY-MM-DD.
CLCK	Time and date. Default for RTC channel.
VBAT	Internal battery voltage. Default for SYS channel.
VEXT	External supply voltage.
IEXT	External supply voltage.

channel

Syntax: <type><number>
type: A – analog, D – digital, RTC – real time clock, SYS – system variables.
number: number from 0 to number of channels-1, omitted for RTC and SYS channel.

E.g.: A0, A3, D0
For differential measurements: <+channel>-<-channel>, e.g. A1-A0.
For byte value: <highest bit>-<lowest bit>, e.g. D3-D0

GAIN

Sets PGA gain. Supported values are 1, 2, 4, 8, 16, 32 and 64. Default and recommended is 1. Gain is taken into account for value output, i.e. no additional scaling is necessary.

BUFF
Turn buffer for analog channels on or off. Default and recommended is on.

MATH
Applies 1st order polynomial to measured value, i.e. scaling and offset addition. It is applied before algorithm that gives physical value (e.g. Platinum RTD).

FRMT
Define output format string. FRMT must be the last parameter and ends at the end of the line. C language syntax is used. Integer value is given for pure digital channels (%d, %o, %x or %X type), whereas float value is used for analog channels, temperatures and system channel (%f, %e, %E, %g or %G type). Useful to reduce precision and to give units to results. Default is %d for integer values and %f for analog values. The parameter is completely ignored for RTC channel. Maximum length is 15 characters.

Example

Configuration file (config.txt):

```
PER 5
TIME@RTC
A0
A1 FRMT %.2f
A3-A2 FRMT %.2f
PTx@A4 MATH 10 0
TEMP@D3
D2-D0
```

Sample every 5 seconds. Make 7 measurements: time, 2 single ended voltages, 1 differential voltage, RTD temperature, temperature of 1-wire sensors, 3-bit value.

Output file (output.txt):

```
Starting datalogger, 2 channels, configuration:
PER 5
TIME@RTC
A0
A1 FRMT %.2f
A3-A2 FRMT %.2f
PTx@A4 MATH 10.000000 0.000000
TEMP@D3
D2-D0
1-wire sensors on D3:
28C358110100006F
28954B0202000095
Log started at: 16:18:00 2009-08-18
Log stopped at: 16:18:57 2009-08-18
16:18:45; 3.763444; 1.23; 0.45; 45; 47; 46; 5
```

```
16:18:50; 3.763445; 1.23; 0.45; 45; 47; 46; 5
16:18:55; 3.763442; 1.23; 0.45; 45; 47; 46; 5
```

Interpretation:
First sample was taken at 2009-08-18 16:18:00. Logging process was manually stopped at 2009-08-18 16:18:57. If logging is stopped because of full card or empty battery, this info ("(Card)" or "(Bat) ") is written at the end of Log stopped line. If this line is absent (filled with spaces), it is indication that logging ended in an uncontrolled manner (e.g. the card was removed or system power was lost).
Voltage of 3.76344 V is present between A0 and ground.
Voltage of 1.23 V is present between A1 and ground.
Voltage of 0.45 V is present between A3 and A2.
Platinum sensor has temperature of 45 °C (math is for PT100 and excitation current of 1 mA or PT1000 and excitation current of 0.1 mA).
Two 1-wire sensors with addresses 28C358110100006F and 28954B0202000095 were detected on D3 and have temperatures of 47 °C and 46 °C.
Pins D2 and D0 are at logical one, while D1 is at logical zero.

Real time clock setup

Internal RTC of the datalogger can be set by writing the desired date and time to a file named set_clk.txt. The file is parsed when START/STOP key is pressed and clock set if deletion of the file is successful. In that case logging will not start. Date and time must be in the format: YYYY-MM-DD HH:MM:SS. Additional internal battery is provided for independent power of RTC.

RS-485 commands

Only one command is allowed in a packet. Maximum length of user data in a packet is currently 248 bytes. If the command is not a query, nothing is returned.

*IDN?

Return product identification string. The string include last compile date.

*CLS

Clears error queue.

*ADR <address>

*ADR?

Sets or reads RS-485 device address. Address set will be stored to FLASH memory and taken into account on next system start-up.

LOG:RUN ON/OFF

LOG:RUN?

Start or stop logging process or query state. Configuration is always taken from config.txt file and results are output to output file.

CHAN <conf>

CHAN?

Set or read channel configuration for RS-485 query only. The configuration is lost after starting logging process. Syntax is the same as for config.txt file. ^ character can be used instead of new lines. After logging is stopped, its configuration will be used for RS-485 queries.

INIT

Start measuring with current configuration. Nothing is returned. This command can only be used when logging is not active.

MEAS?

Start measuring with current configuration and return result. The format is the same as in output.txt file, but only one sample is measured and returned. This command can only be used when logging is not active.

READ?

Read last sample taken. This command can be used whenever the sample is ready, i.e. after taking the first sample during logging process or after performing measurement with INIT or MEAS? commands.

MMEM:

Subsystem for access to files on SD card. Only files in the root folder can be accessed. Commands supported are :CAT?, :DATA, :DATA? and :DEL. Commands can also be used during logging.

MMEM:CAT?

The CATalog command is query-only and returns information on the current contents and state of the mass storage media. Sizes are in bytes. The returned format is:
<amount_of_storage_used>,<amount_of_storage_available>{,<file entry>}
Each <file entry> is a string in the form:
<file_name>,<file_type>,<file_size>
File type is always empty.
Large listings will span over multiple packets. In that case all packets but last will end with comma, denoting another packet.

MMEM:DATA <file_name>,<data>

The command loads <data> into the file <file_name>. <data> is in 488.2 block format. <file_name> is string data.
The query form is MMEMory:DATA? <file_name> with the response being the associated <data> in block format.

Block format:
#<n><size><binary_data>
<size> is number of useful bytes in the block in decimal format. <n> is number of characters in <size>.

Large files will span over multiple packets. When writing file, subsequent packets will be assumed as part of the file until <size> bytes are transferred. There should be pause of at least 10 ms between packets to allow data to be processed.

MMEM:DEL <file_name>

Deletes a file from the mass storage device.

SYST:ERR?

SYST:ERR:NEXT?

Both commands retrieve an error from a first-in-first-out (FIFO) queue. If more than 19 errors have occurred, the last error stored in the queue is replaced with -350,"Too many errors". If no errors have occurred, the datalogger responds with +0,"No errors". Error queue is cleared on power on and after *CLS command.

Error codes:

0 No error
Error queue is empty.

-100 Command error
Command was not recognized by the datalogger.

-109 Missing parameter
Fewer parameters were received than required for the header.

-113 Undefined header
A command was received that is not valid for the datalogger. Check spelling.

-150 String data error
A string parameter (filename in MMEM:DATA command) was not correctly received. Check that the filename is surrounded with double quotes.

-221 Settings conflict
Command cannot be currently executed. Sampling cannot be triggered (MEAS? or INIT command) and configuration cannot be changed when logging process is active. Use READ? command to retrieve the last sample. Memory card cannot be accessed when USB connection is active.

-250 Mass storage error
There is a problem accessing memory card. Check that the required file exists and that the card is properly formatted and inserted.

-285 Program syntax error
There is a syntax error in configuration given with CHAN command.

-350 Queue overflow
The queue is full because more than 19 errors occurred.

RS-485 protocol

Protocol on top of RS-485 interface is a multi-drop master-slave protocol. Data is transferred in addressed packets. Address of master must be 0. The datalogger will respond to requests and cannot be programmed to continuously send data. Large data blocks (MMEM catalog and files) will span multiple packets.
Data rate is 250 kb/s with standard serial formatting, i.e. 8N1. The bus can be internally terminated with 120 Ω by installing jumper JP107. Jumpers JP105 and JP106 enable pull-up/pull-down resistors to guarantee idle state. These resistors are disabled when datalogger is turned off to save power.
If more than 1 datalogger is used in a system, unique address much be set to each of them.

Byte	**Meaning**	**Description**
0	STX	Start delimiter (0x55)
1	destination	Destination address
2	source	Source address
3	length	Length of payload – n
4…n+4	data	Payload, max 248 bytes
n+5	CRC MSB	CRC-16-IBM checksum
n+6	CRC LSB	polynomial: 0x8005
n+7	ETX	End delimiter (0xAA)

Specifications

Analog inputs

Number	8 single ended / 4 differential any combination possible
Max scanning rate	1 S/s
Resolution	24 bits
Absolute input range*1	0 … 3 V
Input protection	-10 … 10 V
Differential input range	±5 V / PGA
PGA gains	1, 2, 4, 8, 16, 32, 64
Input impedance	80 MΩ
Error (gain=1)*2	± (0.01 % + 15 µV)
Evaluation possible	Platinum RTDs and K-type thermocouples

*1 – Higher input ranges (in different combinations) are available on request.

Current source outputs

Number	4
Current*3	1 mA
Accuracy*2	±0.25 %
Voltage range	-40 … 3.8 V

*2 – Reference voltage tolerance should be added for absolute measurements.
*3 – Other values (in different combinations) are available on request.

Digital inputs

Number	4
Low level	0 … 0.8 V
High level	2 … 5 V
Input protection	-4 … 8.5 V
Input resistance	50 kΩ typical
Protocol supported	1-wire temperature sensors

Supply and reference outputs

+5V accuracy	±2.5 % (linear regulation)
Maximal current	100 mA
+3.3V accuracy	±3 % (switch mode regulation)
Maximal current	500 mA
Ref. voltage accuracy Temp. coefficient	±0.05 %, ±0.01 % on request 10 ppm/°C
Maximal current	9 mA

Data storage

Medium	Secure Digital (SD) card (up to 2 GB)
File system	FAT12, FAT16 or FAT32
Data format	Comma Separated Value (CSV) with user defined formatting

Interfaces

USB

Standard	USB 1.1
Class	Mass Storage Class access to SD card

RS-232 (optional)

Connector	DB9 DTE (male)
Lines	TxD, RxD, RTS, CTS, DSR, DTR

RS-485

Operation	multi-drop device
Speed	250 kb/s

Power supply

External voltage	10 … 60 V
Power (external supply)	5 W maximal (battery charging) 0.3 W typical 0.05 W in sleep mode
Battery (optional)	Pb 3-cell (6 V, 1.2 Ah)*4 or Li-ion 2-cell (7.4 V, 2.2 Ah) - connector for external battery
RTC battery	Lithium cell CR2032
USB supply	100 mA typical (for SD card access only)
Options	- different voltage range - MPP tracking (for PV module power supply) - USB battery charging

*4 – Requires higher enclosure.

Dimensions

Width x Depth	190 x 140 mm^2
Height	30 (50, 70) mm
Weight	320 g without battery 420 g with Li-ion battery 650 g with Pb battery

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