CardWare

SL-73 iButton time logger

Technical description

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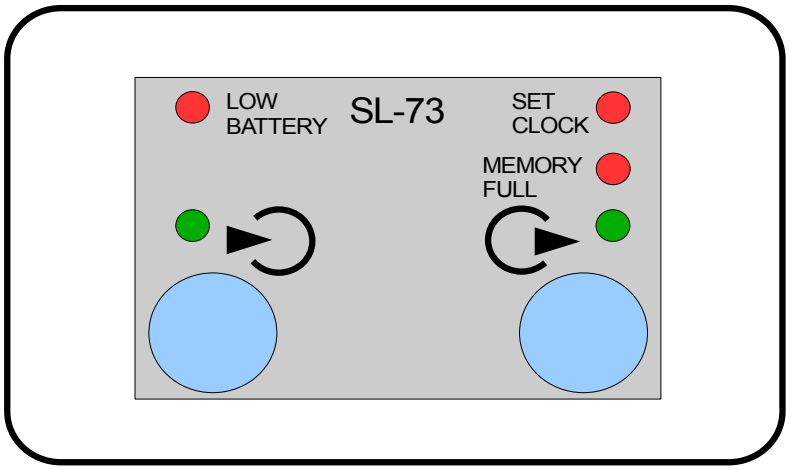
General description

The SL-73 is a compact battery-powered device for reading Dallas iButtons. It has two reading cups and generates time-stamped events when an iButton is touched to either cup. It is ideal for simple time & attendance applications and it is very simple to install and move, since it is totally self-contained and needs no wires, either for power or communication.
The buffer capacity of the unit is 2048 records.
The unit comes with an RS-232 cable (USB/RS232 cable is an option)and a wall-mounting bracket which can be equipped with a small padlock.



1.1. Power

The unit uses a 9V block battery. The current consumption is less than 150uA, so alkaline batteries should provide 4-5 months' of standby use. There is a gold-cap in the unit for providing power to the RAM and clock chip during battery change.
Batteries should be changed as soon as the red LOW BATT LED starts flashing. If this is not done, and the battery is left to discharge further, the clock chip may lose the time and the buffer pointers may also be lost..

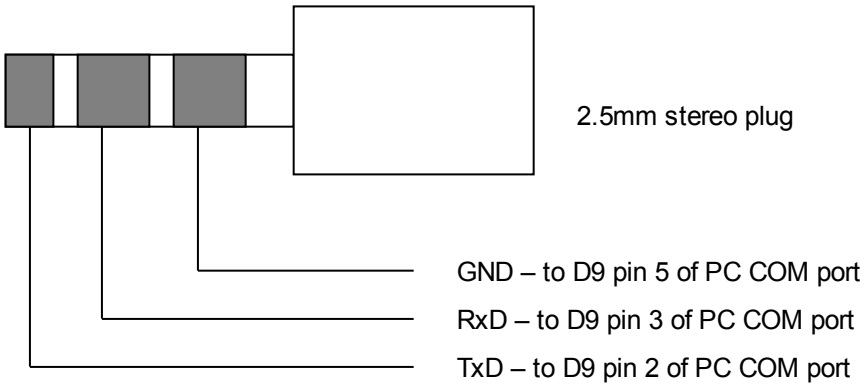
PC communication uses more power than normal use. If the LOW_BATT LED is flashing, you should not connect the SL-73 to a PC for communication. The battery should be changed first.

1.2. Communication

The unit can be connected to a PC's serial port using the cable provided. Alternatively, a USB/RS232 converter cable can be inserted.
While it is connected to the PC, and when the communication program is active, you can download the recorded data from the SL-73 to the PC.

The communication parameters are: 9600 Bd, 8 bit, No parity

The RS-232 connector of the SL-73 is a 2,5mm stereo socket. The cable consists of a 2,5mm stereo plug at one end and a D9F connector for a standard AT RS-232 port. Below is an illustration of how the plug is connected to the PC COM port:



1.3. LED indicators

- READY/READ_0 (bottom left - green) This LED has dual functions
  - short flash once a second indicating operation
  - longer flash when a clocking is made on its associated (LEFT) cup. A beep is also heard.
- READ_1 (bottom right – green) flash when a clocking is made on its associated (RIGHT) cup.

- LOW_BATT (top left - red) Blinks when the battery is low. Registrations can't be made.
- SET TIME (top right – red) Blinks if SL-33A's clock needs to be set by PC
- MEMORY FULL (middle right - red) Blinks synchronously with the READY LED it means that the buffer is full and registrations can't be made.

1. Protocol

When the SL-73 is in the communication mode, it accepts commands from the PC and executes them.
A simple ASCII protocol is used. The individual commands will be explained in the following text.

Notation conventions:

(x) the byte x is transmitted as two hex bytes in ASCII notation (H,L)
e.g. (3Ah) is transmitted as 33h, 41h i.e. '3','A'
<x> the byte x is transmitted as a single character, usually an ASCII control character

Note: to conserve power, the SL-73 is in 'sleep' mode most of the time, waking only to flash the LEDs and read iButtons. When communication is to be established, it is best to send a few non-command characters to the SL-73 before the command letter. Activity on the serial port will wake the SL-73, so by the time the real command letter arrives, it will be ready to process it.
For reading the Status, for example, you might send three or four null characters (00H) at a low baudrate e.g. 300 Bd followed by an 'S' at the nominal baud rate i.e. 9600 Bd.

These wake-up characters are only necessary if there have been more than 5-6 seconds since the last communication. If the records are read out with consecutive 'D' commands, for example, the wake-up characters will only be necessary before the first 'D' command, and even then, only if the first 'D' command was not preceded by another command, like Status.

1.1. Status

This command gets the SL-73's status, which consists of the following information:

- number of buffered registrations
- values of the buffer read and write pointers (service information – no relevance to users)
- current time and date according to the RTC chip of the SL-33A
- firmware version
- serial number of the device

PC⇒SL-73

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'S'
```

SL-73⇒PC

```
(RD_PTR_H)(RD_PTR_L)<20h>
(WR_PTR_H)(WR_PTR_L)<20h>
(CNT_H)(CNT_L)<20h>
(FLAGS)<20h>
(TOTCNT_H)(TOTCNT_L)<CR><LF>
YY.MM.DD hh:mm:ss<CR><LF>
<VNO1><VNO2><VLET><CR><LF>
<SER1><SER2><SER3><SER4>
```

Variables:

(CNT_H),(CNT_L)	number of buffered bytes (= registrations*16)
(RD_PTR_H),(RD_PTR_L)	read pointer
(WR_PTR_H),(WR_PTR_L)	write pointer
(FLAG)	flag byte

b7	b6	b5	b4	b3	b2	b1	b0
FU	NF	EM	BL	IN	-	-	-

- FU Full, set when the record buffer is full
- NF Nearly full, set when there are more than 7000h bytes (1300 records) buffered
- EM Empty, set when there are no registrations buffered
- BL Battery Low, set when the battery voltage is under 7V
- IN Init necessary, set when the RAM has been corrupted, RTC time probably incorrect

(TOTCNT_H),(TOTCNT_L)	totalling counter of registrations
DD.MM.YY hh:mm:ss	date and time
<VNO1><VNO2><VLET>	firmware version, two digits and a letter
<SER1><SER2><SER3><SER4>	serial number, four alphanumeric characters

1.2. Data

This command initiates the transfer of one record (registration) from the SL-73's buffer to the PC. A CRC is sent with the registration data. The receiving program compares this with the CRC calculated from the received data. If the CRCs coincide, the PC returns an <ACK>, if not, it returns a <NAK>.
The terminal moves its read pointer to the next record only if it receives an <ACK>. If the terminal doesn't get an <ACK> after sending a record, it will keep re-sending the same record each time it gets a DATA command from the PC.

Each successful 'D' (DATA) command transfers one record from the buffer of the SL-73. In order to read the whole buffer, the PC needs to send as many 'D' commands as there are records in the SL-73. When the buffer is empty, the SL-33 only sends a <NAK> character as a response to a 'D' command.

PC⇒SL-73

'D'

SL-33⇒PC

(EC)(B1)(B2)(B3)(B4)(B5)(B6)(FC)
(ss)(mm)(hh)(YD)(WD)(TOTCNT_H)(TOTCNT_L)(CRC-TOT) if the buffer is not empty

or

<NAK> if the buffer is empty

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<ACK> if the CRC is correct

or

<NAK> if the CRC is incorrect

Notes:

(EC) Event Code i.e. 00h if the record was made on the left cup and 01 if it was made on the right cup
Generally this will mean 00 - arrival , 01 - departure in time & attendance applications
(B1) to (B6) are bytes of the iButton ROM. B1 is the most significant byte.
(FC) represents the Family Code of the iButton. It is 01h for the DS1990A.
(ss) seconds
(mm) minutes
(hh) hours
(YD) Year/Date – bits 7,6 are the year, bits 5 to 0 are the day

Note: the day is coded in BCD so bits D5 & D4 represent the high digit (0..3) and D3..D0 the low digit (0..9)

b7	b6	b5	b4	b3	b2	b1	b0
Y1	Y0	D5	D4	D3	D2	D1	D0

(WM) Weekday/Month – weekday bits are not used, bits 3 to 0 are the month

b7	b6	b5	b4	b3	b2	b1	b0
W2	W1	W0	M4	M3	M2	M1	M0

Note: the month is coded in BCD so bit M4 represents the high digit (0,1) and M3..M0 the low digit (0..9)

(TOTCNT) High and low bytes of the totalising registration counter
(CRC-TOT) 8-bit CRC of all 15 bytes of the record. The CRC is calculated with the same polynomial as the Dallas 8-bit iButton CRC; starting with CRC and ending with TOTCNT_L. Calculation is done with the binary values of the bytes, not the ASCII characters that are transmitted.

1.3. Time

This command is used to set the time and date on the RTC (Real Time Clock) chip of the SL-73 terminal.
This should be done during initialisation (first use) of the SL-73 or if the time has to be adjusted for any reason (flashing 'SET TIME' LED or wrong time returned by STATUS command)

PC⇒SL-73

<'T'>(Y)(M)(D)(h)(m)(s)(CRC)

SL-73⇒PC

<ACK> if the CRC was OK, the data is copied to the RTC
<NAK> the data is not copied to the RTC, this can be due to:

- bad CRC
- timeout i.e. less than 14 characters being sent after 'T'
- illegal format – not decimal character

Notes:

(Y) year, range of values: '00' to '03'
The year value is offset since the last leap year. The PC software should take care of calculating this number for writing into the RTC and evaluating it after reading the status and in registration data.
The RTC chip has a 2-bit rotating counter, so incrementing a 3 in the years register will result in a 0.

(M) month, range of values: 01 to 12
(D) day, range of values: 01 to 31
(m) minutes, range of values: 00 to 59
(s) seconds, range of values: 00 to 59
(CRC) 8-bit CRC of the first 7 bytes, calculated according to the iButton ROM polynomial
The binary values of the bytes are used for calculation, not the 2-byte ASCII representation used for transmission.

1.4. Initialisation

This is a service command that should not be used during normal use. It resets the registration counter and the read- and write-counters. It also resets the synchronisation flag and stops the 'SET TIME' LED from flashing.

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'I'

1.5. Pack

This is a service command, which should not be used during normal use. It is used for reading out the entire memory of the SL-73. This command makes all registrations available for downloading with the 'D" command, even those that have already been downloaded previously. (In the case of new units, which have not done 2000 registrations yet, the download process will yield nonsense data.)
The command sets the registration counter to the maximum value of 2048 and resets the write and read pointers. This command can be used to extract any records that have been lost due to the battery going flat and the consequential loss of the counter and RD and WR pointers.

PC⇒SL-73

```
'P'
```

2. Parameters kept in RAM

All the variable system parameters are kept in the RTC chip's RAM.
After a reset of the unit, the parameters are checked for validity (using an 8-bit CRC). If the CRC if good, the parameters are used, if not, they are initialised to 0.

CNT_H,CNT_L	Record counters; holds the number of currently stored records in the circular buffer.
RD_PTR_H,RD_PTR_L	Read pointer. Points to the oldest record in the buffer that hasn't been downloaded.
WR_PTR_H,WR_PTR_L	Write pointer. Points to the first free location for storing the next record
TOTCNT_H,TOTCNT_L	Totalling record counter; this is a 16-bit counter that is stored with each record and incremented. It can't be reset by the user.

The purpose of the counter is to keep track of the total number of records made and recognise data loss.

3. Clockings

- There is a 3 second delay after a clocking before another one can be made.
- A serial EEPROM is used for recording the clocking data. This means that clockings can never be lost, even if the battery goes totally flat or is removed.

The clockings are written using a circular buffer concept in order to prolong the lifespan of the EEPROM.
The EEPROM has a declared minimum life expectancy of 100.000 write-cycles for each address. By using this circular buffer system, we can achieve a life expectancy of 100.000 x 2000 clockings.

The buffer pointers are kept in RAM and will be lost if the battery is removed for more than a few minutes. The clocking data can then be recovered by issuing the (P)ack command. This will set the pointers so that the whole contents of the EEPROM can be downloaded as records. This means that records that have already been downloaded previously may get repeated.

Each record consists of 16 bytes, 8 for the iButton data, 5 for the time and date and two for the current state of the totalling counter. (One byte is currently unused.)

Note:

iButton™ is a trademark of Maxim/Dallas Semiconductors