LogDator Communication Manual

v. 1.0

Document Scope

This is the technical manual for the "LogDator" LM-01-00 logger, which is used in the SediMeter SM2.

Document Version

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Use and limitations

This device is intended only for scientific and professional use, whether in a laboratory or in nature under the water. It uses and may emit radio frequency energy, and it is not designed or tested with regard to radio interference. The user is responsible for mitigating any problems that may arise. The device is furthermore exempt from complying with the RoHS directive, and it is not lead free, traditional solder being used.

Copyright

Contents

Data Format

Primitives

Data are defined either as unsigned bytes (8 bits), unsigned words (16 bits), or unsigned long words (32 bits). There are no floating-point numbers, only integers, and only positive integers (unsigned).

Measurement data are stored as 16-bit words. Data with only 12-bit precision have 0000 in the high 4 bits.

The LogDator stores and transmits multi-byte words byte by byte with the least significant byte first (i.e., it is a little-endian like Intel processors, but as opposed to Motorola processors and the normal network order). Example: The three values 01h, 02h, and 0304h are transmitted as 01h, 02h, 04h, 03h (note that the byte order got reversed in the word).

Data Record

The LogDator stores data in a 512-byte page structure on its internal memory. When using a memory card the same 512-byte page and record size is used (in files with extension *.ld2). It is also used in essentially the same form when transmitting data to a host over a serial communications link.

Offset	Label	Bytes/Value	Rows	Columns	Values	Bytes	Description
0	Flags	1	1	1	1	1	Describes optional sensors, and time zone*
1	Second	1	1	1	1	1	0-59
2	Minute	1	1	1	1	1	0-59
3	Hour	1	1	1	1	1	0-23
4	Day	1	1	1	1	1	1-31
5	Month	1	1	1	1	1	1-12
6	Year	2	1	1	1	2	2007- (see note)
8	Temperature	2	1	1	1	2	12-bit value
10	Battery	2	1	1	1	2	12-bit value
12	Interval	2	1	1	1	2	In 1/32768th second units
14	SMRows	4	1	1	1	4	Value: 36
18	SMCols	4	1	1	1	4	Value: 2
22	SMData	2	36	2	72	144	see SMData description
166	AIRows	4	1	1	1	4	Value: 84
170	AICols	4	1	1	1	4	Value: 2
174	AIData	2	84	2	168	336	see AIData description
510	Checksum	2	1	1	1	2	For memory integrity check

Any year from 2007 and up (to 65,535) can be entered. Leap years are handled correctly except the century rule is not implemented (i.e., it will erroneously allow the non-existent date 2100-02-29).

The checksum is a 16-bit SUM calculated on the first 510 bytes (or 255 words, as it were) of the record. When retrieving the data for transmitting, the checksum is calculated again, and if there is a discrepancy, an error is generated. If a memory card is used the application that retrieves the data can do the same check.

This checksum is not transmitted over the serial channel; instead a new checksum (8-bit SUM) is calculated specifically for the transmission.

SediMeter Data description

The sedimeter sensor part of the record is organized as follows:

SMData description	IrLED = OFF	IrLED = ON
	Col1	Col2
Row1	First word	Second word
Row2	Third word	etc.

The time interval between two measurements in the same column is 10 ms. The total measurement time is in the order of 0.4 s. The limit on measurement frequency is not in this part, but in the current-limiting (hole-mounted) 150 Ω resistor on the PCB. The capacitor that provides current to the LEDs needs a few seconds to re-charge (the exact time depends on the supply voltage).

To minimize errors in background light the background is measured a number of times before the light with the LED on, and then another number of times after the LED has been turned off, so that an average can be calculated.

Analog Sensor Data description

The data from the optional analog sensors are organized as follows. This part of the data record is included even if there are no analog sensors in the instrument. Unused byte positions are filled with binary 1:s (erasing the flash memory leaves it filled with 1:s, and writing to it converts some of them to 0:s).

AIData description	AI6, Pressure	AI7, Light
	Col1	Col2
Row1	First word	Second word
Row2	Third word	etc.

The time interval between the two columns in the same row is a fraction of a millisecond. The time interval between two rows is whatever was set as the analog sampling interval, as default 23406/32768th of a second (corresponding to a nominal sampling frequency of 1.4000 Hz).

DataFlags description

Bits 0 and 7 are presently in use. Bits 1 through 6 are reserved, and the following scheme shows their tentative future use.

Bit	When Set	When Cleared
0	UTC	Local Time
1	Pressure sensor on A6	No pressure sensor on A6

2	Light sensor on A7	No light sensor on A7
3-4	Select scale for pressure sensor	
5-6	Select scale for light sensor	
7	Empty data page*	Page contains data record

*Note: Bit 7 signifies “memory checksum error” when stored data is sent over a serial link.

Communication Protocol

Introduction

The LogDator responds to commands from a host. It is thus the slave, and the computer is the master.

The LogDator supports 2 physical interfaces, RS-485 and USB. RS-485 is a network interface, while USB is point to point from an application point of view (addressing is implemented on the physical level with a unique ID for each device, burnt into the USB chip).

USB

Although the LogDator connects to the computer via USB, it actually appears as a serial port for the computer (a COM port). Thus, the correct COM port must be selected. The communication parameters are 921,600 baud, no parity, 8 data bits, 1 stop bit (**961200,N,8,1**). The SediMeter software sets these values, but if another method is used to access the COM port, these values should be set either by the caller, or in the Windows systems settings.

The maximum cable length with USB is 5 m.

RS-485

This is intended for longer cables. The maximal cable length according to specifications in the standard is 1200 m, and the maximum number of devices is 32. The limit for cable length is in the reflections, and the limit for number of devices is in the load.

However, the LogDator has an RS-485 chip that is slew rate limited so that the maximal baud rate is 250,000 instead of 1 million. This may increase the usable cable length. Furthermore, it may be supplied with a chip that has only 1/8th the nominal load, why in theory 256 devices can be on the same net (this is the upper limit anyway since there are only 255 addresses available; this of course assumes that also the computer has 1/8th the nominal load, although the majority of USB-to-RS485-adapters on the market have the standard load.)

Theoretical baud rates: up to 9600 with low power. Up to 250 000 is possible with much higher power consumption using the 3,6 MHz crystal, and high speed low power is possible in the future by special programming employing a calibrated OSC. Using the crystal may warm up the device so as to introduce a thermometer bias. It is not implemented in LogDator software version 1.0. Default: **9600,N,8,1** (9600 baud, No parity, 8 data bits, 1 stop bit).

RS485 ID: Network Address

In RS-485 there must be an application level mechanism for addressing a specific slave. Each slave has an address (NetAddr; RS485 ID), which is one byte with a value from 01h to FFh (h means hexadecimal notation). Each communication from the master starts with the NetAddr byte to indicate the addressee. Each communication from a slave starts with its NetAddr to indicate the sender identity. The slave only listens to communication that starts with its own NetAddr, or with NetAddr = 00h. Only the master uses code 00h, and that is called a broadcast. The slave will respond only to messages addressed to its NetAddr, not to broadcasts.

The NetAddr is set at factory to the same as the serial number for numbers up to 250. Serial numbers 251, 501, etc will restart with NetAddr 001. The user can temporarily change the NetAddr using the NavPin user interface, or the SediMeter software over either USB or Rs-485. The default value will be restored by a Reset (pressing the switch on the LogDator or letting the voltage drop below 1.8 V).

Idle-Line Multiprocessor Format

In order to separate transmissions from multiple devices on the same net, each transmission starts with an address byte, the NetAddr. The idle-line format is used to separate transmissions from each other. If the line has been idle for 10 bits or more, any transmission must start by sending an address byte. Any device transmitting on the net must make sure to wait a minimum of 10 bits after the last transmission ended before starting to send. If they do not, their transmission will be considered part of the previous one, and ignored by all devices (since the actively listening device has received a byte count and only reads that many bytes).

Connections from PCB to USB-COMi-M

K6 Pin#	Function	USB-COMi-M function	USB-COMi-M Pin#
1	“B” (low in idle, i.e., A)	Data- (A)	1
2	“A” (high in idle, i.e., B)	Data+ (B)	2
3	+V	+5V	5
4	GND	GND	6

Note that on K6 in revision B pins 1 and 3 are adjacent, and 2 and 4 are adjacent.

Communication Protocol

RS-485

The CPU is asleep but the RS-485 chip is on. A transmission arrives. The address character is sent to the CPU, in which LogDator software compares it to its NetAddr value.

If it is the same, or 0, the channel is opened and the whole stream received and interpreted.

The bytes from the checksum to the end are XORed, and if the result is not zero, an error is generated and a Repeat command returned (unless it was a broadcast).

The word count value is compared to the received number of words, and if an idle appears before the correct number has been received, an error is generated and a Repeat command returned.

Finally a branch is made based on the value of the command, passing the parameters in registers.

If a command is a broadcast (i.e., the NetAddr in the received command equals 0), the slaves do not respond. Instead the master uses a special command to request a reply, by polling, from one slave at a time. This can be used to synchronize the measurements to the millisecond, although it may take several minutes to transmit all the data from the LogDators at 9600 baud.

USB

USB communication protocol is similar to RS-485, except that the LogDator will send a response even if the NetAddr in the message is 0. It will not, however, respond if the NetAddr is any other value than 0 or the NetAddr set in the LogDator.

Redundancy Check

To check for transmission errors a checksum is calculated. If an error is detected a re-transmission is requested. The receiver can start with the checksum value, and add all the following bytes to that (in 8-bit mode). If the result if zero (00h), the transmission is assumed to have been received correctly. The checksum is thus two's complement of the sum of the bytes without carry.

Use the checksum error rate as a diagnostic tool for the quality of the transmission lines. If you get such errors, check for corrosion on contacts and similar.

Communication Sentence Structure

Each message consists of the following five parts:

Content	NetAddr	CheckSum	Command	NumWords	Data
Length in bytes	1	1	1	1	0, 2, 4, … 508, 510
Start byte position	0	1	2	3	4
Explanation	Either 00h for broadcast, or 01h…FFh (the RS-485 address of the slave; ignored in USB)	Two's complement of a sum without carry of all bytes in positions 2…n	Indicates the type of communication	The number of 2-byte words in the Data segment of the sentence	Either parameters to the slave, or data requested by the master

This basic sentence structure is used in both directions, as exemplified here.

From master to slave

NetAddr: Either 00h for broadcast, or a number from 01h to FFh to address a specific slave.
CheckSum: Two's complement of the sum of all the bytes to follow in the transmission.
Command: The instruction for the slave(s) to act upon.
Words: The number of 2-byte words of parameters being transmitted.
Data: The parameters for the command. Always an even number of bytes.
Example: "006E 0100"

From slave to master

NetAddr: A number from 01h to FFh identifying the transmitting slave.
CheckSum: Two's complement of the sum of all the bytes to follow in the transmission.
Command: The instruction from the master that the slave is responding to.
Words: The number of 2-byte words of data being transmitted.
Data: The data requested by the master. Always an even number of bytes.

Commands

Conventions

The structure of each command sentence is described in a table, as in this example (the Set Clock command):

Position	Hex Value	Decimal Value	Char(s)	Type	Meaning
0	01…FFh	1-255		Byte	NetAddr
1	00…FFh	0-255		Byte	Checksum
2	3Eh	62	>	Byte	Command: SetClk
3	01h	1		Byte	Words in data field
4	4F4Bh	20299	OK	Word	OK*

- Position: The position of the first transmitted byte in the serial transmission, starting at 0, which is always the NetAddr (00h for an RS-485 broadcast, 01h…FFh for addressing a specific LogDator). In USB this has no meaning so 00h can be used regardless of what the tables say.
- Hex Value: The hexadecimal value or value range for the field.
- Decimal value: The decimal value or value range for the field.
- Char(s): The ASCII character equivalent for human-readable parameters.
- Type: The data type, which can be Byte (8 bits), Word (16 bits), or Long (32 bits), and represent either characters or positive integers.
- Meaning: An explanation of what the parameter signifies.

The length of the transmission in bytes is always four (for the 4 values in the header) plus the length of the data field, which starts on position 4. The number of bytes in the data field is twice the numerical value of position 3. In the above example, the total transmission length is thus 4 + 2 * 1 = 6 bytes.

List of All Commands

The commands have been given codes that correspond to ASCII characters so that they can be referred to by a single letter. They are described on the following pages. The columns .VI and .s43 refer to subroutines that handle the code in the computer software and LogDator assembler, respectively. The USB and RS485 columns mark the minimum functionality in each mode. In reality most commands work in RS485.

Shorthand	Char	Hex	Full Name	.VI	.s43	USB	RS485
GetMemInfo	B	42	Get Memory Information	GetMemoryInfo.vi	GetMemInfo	Y	Y
Download	D	44	Download One Record	Download.vi*	Download	Y	-
GetSettings	F	46	Get Clock, Start, Interval, Rate, Samples	GetSettings.vi	GetSettings	Y	Y
SetSettings	H	48	Set Clock, Start, Interval, Rate, Samples	SetSettings.vi	SetSettings	Y	Y
GetMode	J	4A	Get Mode & RS-485 baud rate	GetMode.vi	GetMode	Y	-
SetMode	L	4C	Set Mode & RS-485 baud rate	SetMode.vi	SetMode	Y	-
MeasureNow	N	4E	Measure Now	MeasureNow.vi	MeasureNow	-	Y
GetPrevious	P	50	Get Previous Data Record	GetPrevious.vi*	GetPrevious	-	Y
Err	R	52	Error, Repeat!	—	CmdR	Y	Y
MarkRead	T	54	Marak As Read	MarkRead.vi	MarkRead	Y	Y
Erase	V	56	Erase Internal Memory	EraseMemory.vi	Erase	Y	-
GetNetAddr	X	58	Get RS-485 NetAddr	GetNetAddr.vi	GetNetAddr	Y	Y
SetNetAddr	Z	5A	Set RS-485 NetAddr	SetNetAddr.vi	SetNetAddr	Y	-

*The decoding of the data string is handled by UnpackDataRecord.vi, a sub-VI.

Memory Handling

The LogDator stores data to the internal memory unless a valid MMC card is present, in which case it uses that.

The LogDator keeps a counter of how many records there are in memory, and this NumRec counter can be retrieved using the GetMemInfo command. If the counter equals 0, the next record will also be written to page 0. There are 4096 pages in the internal flash, so the last

record has number 4095. The counter is reset when an Erase command is set, after erasing all the pages that were in use. It is possible to download any page in random order, but the standard procedure is to start with 0 and end with NumRec-1.

The NumRec counter is stored in RAM why it is lost if VCC drops below 1.8 V. After a Reset the value is restored based on memory contents (bit 7 in byte 1 equals 0 if the page contains a record).

Get Memory Information, B

Purpose: To retrieve essential parameters for downloading data and managing the device memory.

Type: To a single slave.

From Master

Position	Hex Value	Decimal Value	Char(s)	Type	Meaning	Assem. Label
0	01…FFh	1-255		Byte	NetAddr	NetAddrIN
1	BEh	190		Byte	Checksum	ChkSumIN
2	42h	66	B	Byte	Command: GetMemInfo	UARTcmdIN
3	00h	0		Byte	Words in data field	wordsIN

From Slave

Position	Hex Value	Decimal Value	Char(s)	Type	Meaning	Assem. Label
0	01…FFh	1-255		Byte	NetAddr	NetAddrOUT
1	00…FFh	0-255		Byte	Checksum	ChkSumOUT
2	42h	66	B	Byte	Command: GetRecs	UARTcmdOUT
3	02h	2		Byte	Words in data field	wordsOUT
4	1000h	4096		Word	Pages of internal memory, M	MemSize
6	0000…1000h	0-4096		Word	Next Free Page, NumRec, N	WRP
7	0000…1000h	0-4096		Word	Next Un-Read Page, NewRec, U	RRP

The 2 MB standard internal memory can hold 4096 data records, each occupying one page of 512 bytes. The number of records in memory equals N, and the free memory is the difference between M and N. The number of new records equals N minus U. Only data from the beginning to U may be erased (using command V).

Download One Record, D

Purpose: To retrieve one data record from the internal memory of the LogDator.

Type: To a single slave.

From Master

Position	Hex Value	Decimal Value	Char(s)	Type	Meaning	Assem. Label

0	01…FFh	1-255		Byte	NetAddr	NetAddrIN
1	00…FFh	0-255		Byte	Checksum	ChkSumIN
2	44h	68	D	Byte	Command: Download	UARTcmdIN
3	01h	1		Byte	Words in data field	wordsIN
4	0000h… 0FFFh, FFFFh	0-4095, 65535		Word	Record number to download. FFFFh means “download next unread record”.	paramsIN

Use this command to request one record at a time.

From Slave

Position	Hex Value	Decimal Value	Char(s)	Type	Meaning	Assem. Label
0	01…FFh	1-255		Byte	NetAddr	NetAddrOUT
1	00…FFh	0-255		Byte	Checksum	ChkSumOUT
2	44h	68	D	Byte	Command: Download	UARTcmdOUT
3	FFh	255		Byte	Words in data field	wordsOUT
4	00-FFh	0-255		Byte	DataFlags*	
5	00…3Bh	0-59		Byte	Second	
6	00…3Bh	0-59		Byte	Minute	
7	00…17h	0-23		Byte	Hour	
8	01…1Fh	1-31		Byte	Day	
9	01…0Ch	1-12		Byte	Month	
10 (0Ah)	07D7h…	2007-		Word	Year	
12 (0Ch)	0000…FFFFh	0…65535		Word	Temperature	
14 (0Eh)	0000…FFFFh	0…65535		Word	Battery	
16 (10h)	0000…FFFFh	0…65535		Word	Interval in 1/32768th seconds	
18 (12h)	0000 0024h	36		Long	SMRows	
22 (16h)	0000 0002h	2		Long	SMCols	
26 (1Ah)	0000…FFFFh	0…65535		Word	SMData	
170(AAh)	0000 0054h	84		Long	AIRows	
174 (AEh)	0000 0002h	2		Long	AICols	
178 (B2h)	0000…0FFFh	0…4095		Word	AIData	

*Bit 7, when set, signals a memory checksum error. The data are still transmitted but one or more bits are wrong in the result (unless of course the error occurred in the checksum only).

The record is always the same length, regardless of how many analog samples, if any, were actually taken. Unused positions are filled with 1:s (FFFFh). All used positions in AIData have bits 12 to 15 low.

Always read the values returned, even if they are indicated as constant here, since they may become variables in future releases.

Get Settings, F

Purpose: Get the date, time, and logging settings currently in the LogDator.

Type: To a single slave.

From Master

Position	Hex Value	Decimal Value	Char(s)	Type	Meaning	Assem. Label
0	01…FFh	1-255		Byte	NetAddr	NetAddrIN
1	BAh	186		Byte	Checksum	ChkSumIN
2	46h	60	F	Byte	Command: GetSettings	UARTcmdIN
3	00h	0		Byte	Words in data field	wordsIN

The recommended usage is to send this command, edit the setting or settings that need editing, and then use the SetSettings command to send them back. This command can also be used after a SetSettings to make sure that everything was set correctly.

From Slave

Position	Hex Value	Decimal Value	Char(s)	Type	Meaning	Assem. Label
0	01…FFh	1-255		Byte	NetAddr	NetAddrOUT
1	00…FFh	0-255		Byte	Checksum	ChkSumOUT
2	46h	60	F	Byte	Command: GetSettings	UARTcmdOUT
3	09h	9		Byte	Words in data field	wordsOUT
4	00…01h	0-1		Byte	F_Flags*	optFlags
5	00…3Bh	0-59		Byte	Clock: Second	DEC_second
6	00…3Bh	0-59		Byte	Clock: Minute	DEC_minute
7	00…17h	0-23		Byte	Clock: Hour	DEC_hour
8	01…1Fh	1-31		Byte	Clock: Day	DEC_day
9	01…0Ch	1-12		Byte	Clock: Month	DEC_month
10 (0Ah)	07D7h…	2007-		Word	Clock: Year	DEC_year
12 (0Ch)	00…3Bh	0-59		Byte	Start: nextSecond	nextSecond
13 (0Dh)	00…3Bh	0-59		Byte	Start: nextMinute	nextMinute
14 (0Eh)	00…17h	0-23		Byte	Start: nextHour	nextHour
15 (0Fh)	00…3Bh	0-59		Byte	Interval: intSecond	intSecond
16 (10h)	00…3Bh	0-59		Byte	Interval: intMinute	intMinute
17 (11h)	00…17h	0-23		Byte	Interval: intHour	intHour
18 (12h)	0000…FFFFh	0-65536		Word	Sampling rate**	analogInt
20 (14h)	00…7Ch	0-84		Byte	Number of samples	samples
21 (15h)	00…63h	0-99		Byte	Clock: Fractional seconds***	N/A, created from TBR

*Flags: Bit 0, when set, indicates that all times are in UTC, otherwise they are in local time (the user must keep track of changes in time zone or daylight savings time/seasonal time changes, if not using UTC). The remaining bits should be ignored by the master, can be either 1 or 0.

**The optional analog channel sampling rate within a measurement is sent as a 16-bit word where each bit corresponds to clock-cycles of 1/32768th second. E.g., for 0.5 s intervals send 16384, equal to 4000h. The default is 23406, which gives a sampling frequency of 1.4000 Hz (this makes it possible to sample with a continuous rate if the measurement

interval is 1 minute, which is the default, by taking 84 samples per 60 seconds). The maximal interval is 2 s.

***In 1/256th seconds (8-bit value).

Set Settings, H

Purpose: Set the date, time, and logging settings in the LogDator.

Type: Broadcast or to single slave.

From Master

Position	Hex Value	Decimal Value	Char(s)	Type	Meaning
0	00…FFh	0-255		Byte	NetAddr
1	00…FFh	0-255		Byte	Checksum
2	48h	72	H	Byte	Command: SetSettings
3	09h	9		Byte	Words in data field
4	00…01h	0-1		Byte	H_Flags*
5	00…3Bh	0-59		Byte	Clock: Second
6	00…3Bh	0-59		Byte	Clock: Minute
7	00…17h	0-23		Byte	Clock: Hour
8	01…1Fh	1-31		Byte	Clock: Day
9	01…0Ch	1-12		Byte	Clock: Month
10 (0Ah)	07D7h…	2007-		Word	Clock: Year
12 (0Ch)	00…3Bh	0-59		Byte	Start: nextSecond
13 (0Dh)	00…3Bh	0-59		Byte	Start: nextMinute
14 (0Eh)	00…17h	0-23		Byte	Start: nextHour
15 (0Fh)	00…3Bh	0-59		Byte	Interval: intSecond
16 (10h)	00…3Bh	0-59		Byte	Interval: intMinute
17 (11h)	00…17h	0-23		Byte	Interval: intHour
18 (12h)	0000…FFFFh	0-65536		Word	Sampling rate**
20 (14h)	00…7Ch	0-84		Byte	Number of samples
21 (15h)	00h	0		Byte	Reserved

*The H_Flags have the following meaning:

Bit	When Set	When Cleared
0	UTC time	Local Time
1	Clear Timer Counter	Continue Timer Count
2	Set Clock	Do not set the clock
3	Set Start	Do not change the time of next measurement
4	Set Interval	Do not change the measurement interval
5	Set Rate	Do not change the sampling rate
6	Set Count	Do not change the number of samples to take
7	Reserved, set high	

Flag 0 indicates that the clock is being set in UTC as opposed to the local time zone. Setting it in UTC is recommended since it eliminates potential errors caused by varying time zones and seasonal time. (A corresponding flag is set in the data records.)

When the SediMeter receives this command it resets its real-time counter. For sub-second synchronization the command should be sent at or slightly before the top of the second. [Note: The transmission latency in seconds can be estimated by dividing 220—the number of bits in the transmission—with the baud rate, since baud rate in this case equals bits per second. It is ca 23 ms at 9600 baud.]

This command can be broadcast to the entire network to synchronize the clocks. Send it at an integer second, or so many milliseconds earlier as it takes for the transmission to arrive.

The slaves will not respond to a broadcast, so to check that the command was successful the master can send the GetSettings command to each of the slaves.

From Slave

Position	Hex Value	Decimal Value	Char(s)	Type	Meaning
0	01…FFh	1-255		Byte	NetAddr
1	B8h	184		Byte	Checksum
2	48h	72	H	Byte	Command: SetSettings
3	00h	0		Byte	Words in data field

If the slave was unable to understand the command or parameters it will instead send the Error (R) command. To make sure the parameters are set a GetSettings (F) command can be sent after this.

Get Mode, J

Purpose: Find out instrument mode and RS-485 baud rate.

Type: To a single instrument.

Note: This command can be used over USB as a way to find out the necessary parameters to establish an RS-485 communication.

From Master

Position	Hex Value	Decimal Value	Char(s)	Type	Meaning
0	01…FFh	1-255		Byte	NetAddr
1	B6h	182		Byte	Checksum
2	4Ah	74	J	Byte	Command: GetMode
3	00h	0		Byte	Words in data field

The slave will respond as follows.

From Slave

Position	Hex Value	Decimal Value	Char(s)	Type	Meaning
0	01…FFh	1-255		Byte	NetAddr
1	00…FFh	0-255		Byte	Checksum
2	4Ah	74	J	Byte	Command: GetMode
3	01h	1		Byte	Words in data field
4	00…02h	0-2		Byte	ModeNr*
5	00…05h	0-5		Byte	RS485baud rate**

*The possible values are: 0 = Sleep mode, 1 = Log Mode, 2 = RS485 mode.

**The baud rates are: 0 for 4800, 1 for 9600, 2 for 28800, 3 for 56000, 4 for 115200, and 5 for 250000 baud.

Set Mode, L

Purpose: Change operation mode and or RS-485 baud rate.

Type: Broadcast or to a single slave.

Note 1: If this command is sent on an RS-485 network it must be sent as a broadcast, since the entire network must be changed simultaneously. See note 2, though.

Note 2: If the mode is changed via an RS-485 network to another mode, the connection will be lost with the instrument(s) immediately. The only ways to return to RS485 mode is via a USB connection, the physical user interface, or by creating a Reset. Thus, the advice is *NEVER to use this command to an RS-485 network* with instruments deployed *out of reach*.

From Master

Position	Hex Value	Decimal Value	Char(s)	Type	Meaning
0	00…FFh	0-255		Byte	NetAddr
1	00…FFh	0-255		Byte	Checksum
2	4Ch	76	L	Byte	Command: SetMode
3	01h	1		Byte	Words in data field
4	00…02h	0-2		Byte	ModeNr*
5	00…05h	0-5		Byte	RS485baud rate**

*The possible values are: 0 = Sleep mode, 1 = Log Mode, 2 = RS485 mode.

**The baud rates are: 0 for 4800, 1 for 9600, 2 for 28800, 3 for 56000, 4 for 115200, and 5 for 250000 baud.

"Log mode" is a stand-alone mode in which the RS-485 integrated circuit is in sleep mode (meaning that the instrument will not respond to RS-485 traffic), and in which measurements are being made at the set interval. In "Sleep mode" the real-time clock is off as well as the RS-485 chip, but the instrument will still wake up if a USB cable is connected (no measurements can be made with the clock off). "RS485 mode" is the default; measurements are only made on request in that mode.

From Slave

Position	Hex Value	Decimal Value	Char(s)	Type	Meaning
0	01…FFh	1-255		Byte	NetAddr
1	B4h	180		Byte	Checksum
2	4Ch	76	L	Byte	Command: SetMode
3	00h	0		Byte	Words in data field

Immediately after sending this response the RS-485 IC on the LogDator will be put in low power mode, in which it will not detect any further communications.

Measure Now, N

Purpose: Trigger an immediate measurement of the SediMeter sensor immediately followed by the optional analog sensors. When done the results will be ready in a buffer from where they can be downloaded using the command GetPrevious (P).

Type: Broadcast or to single slave.

From Master

Position	Hex Value	Decimal Value	Char(s)	Type	Meaning
0	00…FFh	0-255		Byte	NetAddr
1	B2h	178		Byte	Checksum
2	4Eh	78	N	Byte	Command: MeasureNow
3	00h	0		Byte	Words in data field

This command can be broadcast to trigger a synchronous measurement over an entire RS-485 network. In that case the slaves will carry out a measurement, but they will not confirm having received this command.

Use the GetPrevious (P) command to request the data from one instrument at a time, after waiting for an appropriate amount of time (59.6 s should be adequate with default settings).

Note that a second Measure Now command can be sent before requesting the previous data, as long as the request is made before the second measurement is completed. Example: The master broadcasts command N at time 00:00:00. A new command N is broadcast at 00:01:00. Starting at 00:01:01 the master sends out command P to one instrument at a time. At 00:02:00 command N is broadcast a third time, and so on. This enables the continuous collection of analog channel data without any interruption for communication, and complete synchronization between all instruments every minute. (This gives sufficient precision for determining wave direction, which is not possible if using the built in real time clock over times longer than a few hours.)

From Slave

Position	Hex Value	Decimal Value	Char(s)	Type	Meaning
0	01…FFh	1-255		Byte	NetAddr
1	B2h	178		Byte	Checksum
2	4Eh	78	N	Byte	Command: MeasureNow
3	00h	0		Byte	Words in data field

Get Previous Measurement, P

Purpose: Request the buffered last complete measurement data record.

Type: To a single slave.

Note: Wait at least 0.5 s after sending N before sending P, to avoid errors caused by conflicting requests for MPU resources.

From Master

Position	Hex Value	Decimal Value	Char(s)	Type	Meaning

0	01…FFh	1-255		Byte	NetAddr
1	B0h	176		Byte	Checksum
2	50h	80	P	Byte	Command: GetPrev
3	00h	0		Byte	Words in data field

Use this command to request the data from one instrument at a time after sending the Measure Now command (N), and waiting an appropriate amount of time (59.6 s when using default settings). If a measurement is not requested in time using this command, it will get overwritten in the case that another Measure Now (N) command was sent later. Use the time of the measurement to check which data record it is that was retrieved.

From Slave

Position	Hex Value	Decimal Value	Char(s)	Type	Meaning
0	01…FFh	1-255		Byte	NetAddr
1	00…FFh	0-255		Byte	Checksum
2	50h	80	P	Byte	Command: GetAll
3	59h…FFh	89-255		Byte	Words in data field
4	00-FFh	0-255		Byte	DataFlags*
5	00…3Bh	0-59		Byte	Second
6	00…3Bh	0-59		Byte	Minute
7	00…17h	0-23		Byte	Hour
8	01…1Fh	1-31		Byte	Day
9	01…0Ch	1-12		Byte	Month
10 (0Ah)	07D7h…	2007-		Word	Year
12 (0Ch)	0000…FFFFh	0…65535		Word	Temperature
14 (0Eh)	0000…FFFFh	0…65535		Word	Battery
16 (10h)	5B6Eh (def.)	23406 (def.)		Word	Interval in 1/32768th seconds
18 (12h)	0000 0024h	36		Long	SMRows
22 (16h)	0000 0002h	2		Long	SMCols
26 (1Ah)	0000…FFFFh	0…65535		Word	SMData
170(AAh)	0000 0000… 0000 0054h	0-84		Long	AIRows
174 (AEh)	0000 0002h	2		Long	AICols
178 (B2h)	0000…0FFFh	0…4095		Word	AIData

*These Flags the same as used for data stored on Flash memory. Bit 7 has no significance and is always 0 (for logged data bit 7 means memory checksum error when set).

The SediMeter Data is sent in the following order: Detector 1 with IrLED OFF; detector 1 with IrLED ON; detector 2 with IrLED OFF, etc. The table consists of 2 x 36 words, each 16 bits long (little-endian). Each value is created by adding 16 measurement values from the 12-bit A/D converter.

Error, R

Purpose: Response to any command to which the instrument is unable to comply. If bit 2 is set the appropriate response on behalf of the master is to resend the command.

Type: From slave to master. Note that this is a unique command.

From Slave

Position	Hex Value	Decimal Value	Char(s)	Type	Meaning
0	01…FFh	0-255		Byte	NetAddr
1	00…FFh	0-255		Byte	Checksum
2	52h	82	R	Byte	Command: Error
3	01h	1		Byte	Words in data field
4	00…FFh	0-255		Byte	The command byte, as received
5	00…FFh	0-255		Byte	ErrorFlags*

*ErrorFlags: Bit 0 = unknown command, bit 1 = bad parameters, bit 2 = checksum error, bits 3…7 = reserved.

NB: The R is checked for in GetReply.vi, but as of yet the data bytes are not decoded (although they are returned as Data, so the caller can use them, but it is better to add an error handler within GetReply).

Mark As Read, T

Purpose: Marks all records as read without downloading or erasing memory.

Type: Broadcast or to single slave.

From Master

Position	Hex Value	Decimal Value	Char(s)	Type	Meaning
0	00…FFh	0-255		Byte	NetAddr
1	ACh	172		Byte	Checksum
2	54h	84	T	Byte	Command: MarkRead
3	00h	0		Byte	Words in data field

This command marks all records as read by setting the Read Record Pointer equal to the Write Record Pointer. It is useful as a way to discard data collected, e.g., during tests or setup procedures, without having to download them.

This command can be safely broadcast over an RS-485 network.

From Slave

Position	Hex Value	Decimal Value	Char(s)	Type	Meaning
0	01…FFh	1-255		Byte	NetAddr
1	00…FFh	0-255		Byte	Checksum
2	54h	84	T	Byte	Command: MarkRead
3	00h	0		Byte	Words in data field

No response is sent if the command is addressed to NetAddr 00h over an RS-485 network, but a response is always sent if USB is used regardless of NetAddr (since that value is ignored by the LogDator).

Erase Internal Memory, V

Purpose: To clear the internal memory of the LogDator from previously recorded data.

Type: To a single slave.

Note: The data will be permanently deleted. In standard operation it is not necessary or recommended to erase the memory using this command. Using the standard round-robin routines prolongs the lifespan of the memory. This command is intended for, e.g., clearing the memory before transferring the instrument to a new project.

From Master

Position	Hex Value	Decimal Value	Char(s)	Type	Meaning
0	01…FFh	1-255		Byte	NetAddr
1	AAh	170		Byte	Checksum
2	56h	86	V	Byte	Command: Erase
3	00h	0		Byte	Words in data field

This command causes the LogDator to erase all previously used memory locations. It will not erase memory locations that are marked as un-read. The data records must be read first (using the Download, D, command) before the LogDator accepts a command to erase them. Alternatively, the Mark As Read (T) command can be used first.

From Slave

Position	Hex Value	Decimal Value	Char(s)	Type	Meaning
0	01…FFh	1-255		Byte	NetAddr
1	00…FFh	0-255		Byte	Checksum
2	56h	86	V	Byte	Command: Erase
3	01h	1		Byte	Words in data field
4	00…03h	0-3		Byte	Memory Flags*
5	00h	0		Byte	Reserved

*Bit 0 gets set when there are records in memory that have not yet been read. Remaining bits are zero (0).

This confirmation reply will be sent once the erase has been successfully completed, or abandoned. If the flag byte equals zero the operation was successful.

Get RS-485 NetAddr, X

Purpose: Find out the net address of a single instrument, or to poll an entire network to see which network addresses are represented.

Type: Broadcast or to single slave.

From Master

Position	Hex Value	Decimal Value	Char(s)	Type	Meaning
0	00h	0		Byte	NetAddr, zero for broadcast
1	A8h	168		Byte	Checksum
2	58h	88	X	Byte	Command: GetNetAddr
3	00h	0		Byte	Words in data field

Each instrument that receives this command will respond at the same time.

From Slave

Position	Hex Value	Decimal Value	Char(s)	Type	Meaning
0	01…FFh	1-255		Byte	NetAddr
1	A8h	168		Byte	Checksum
2	58h	88	X	Byte	Command: GetNetAddr
3	00h	0		Byte	Words in data field

An alternative method to find the NetAddr is to send any command over USB, since the instrument will always start a reply with its RS-485 network address.

Set RS-485 NetAddr, Z

Purpose: Set the net address of a single slave connected to the master.

Type: Broadcast (therefore *only one slave must be connected* if on RS-485).

From Master

Position	Hex Value	Decimal Value	Char(s)	Type	Meaning
0	00h	0		Byte	NetAddr, zero for broadcast
1	00…FFh	0-255		Byte	Checksum
2	5Ah	90	Z	Byte	Command: SetNetAddr
3	01h	1		Byte	Words in data field
4	01…FFh	1-255		Byte	New NetAddr
5	00h	0		Byte	Reserved

The slave will respond as follows, using its newly assigned Net Address.

From Slave

Position	Hex Value	Decimal Value	Char(s)	Type	Meaning
0	01…FFh	1-255		Byte	NetAddr
1	A6h	166		Byte	Checksum
2	5Ah	90	Z	Byte	Command: SetNetAddr
3	00h	0		Byte	Words in data field

The NetAddr from the slave should match the New NetAddr sent by the master.