Geosignal ™

Datalogger F2408 C6

Version: Customisable

This document is an example of a possible User Manual. It is only indicative of some features of F2408C6 but must not be used as reference of your custom F2408C6 neither as indication of the full capability of F2408C6.

Table of Contents

Introduction

Thank you for purchasing F2408 Custom.

F2408C6 is a data logger provided with up to 6 synchronous acquisition channels and with up to 32 Mega bytes of SPI Flash Memory.

- Each channel is provided with 2 differential inputs and PGA (Programmable Gain Amplifier).
- Customisable counters and outputs to drive external electronics. .
- Customisable 24/16 bit resolution.
- RS232 or TTL/USB output.
- 5A electronic switch on board
- Upgradable firmware.

The data logger can acquire data in slow and fast mode at the same time.
Slow mode acquires one set of readings at the set scan rate (factory default one second) from channels 8-13
Fast mode acquires a windows of readings up to 16 KHZ at a different scan rate from channels 0-5 (firmware specific).

Programming can be carried out from a communication software like HyperTerminal ©
(HyperTerminal is property and Trade Mark of Hilgraeve Inc.) or minicom available under GNU licence and running under Linux.
A simple Windows application is also available.
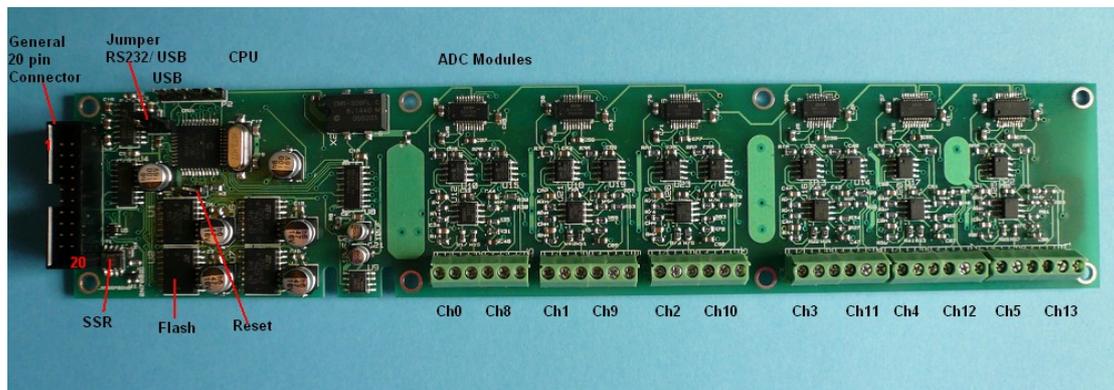
Getting Started
(This section is inherent to the specific firmware that was designed to modem connection it can be adapted to be easily programmed and downloaded by one of our Windows applications)

Programming
1. Connect the data logger to the serial port of a PC by using the special cable and start a terminal software.
2. Set the USB/RS232 jumpers in accordance with your communication settings.
3. If the a USB cable is connected check the correct port settings usually COM2 or COM5 .
4. Power the data logger.
5. On closure of reset terminals and reopening a message is displayed on the screen.
6. Check scan rates, PGA settings (commands G, P, S).
7. If this set of parameters is correct and is going to be used in future then save it to memory (command ;:)
8. Set the correct time (registers T, U) otherwise clear those to zero on synchronisation see below.

9. Set the starting time for the acquisition (registers W, X). For example:"A;XA60;W starts the acquisition at 00:01:00 from the reset).
10. Synchronise (command =). For example: "A;B;C;=" clears anything to zero: synchronisation becomes time zero 00:00:00).
11. issue the command "<" to start the acquisition at due time.
12. Wait the acquisition to start and to repeat itself at scan rate
13. Wait for the measure to start a the set time and repeat at given scan rate
14. Stop the acquisition by issuing the command ">"

Downloading Data
1. Check the presence of archive Archives in memory (command F).
2. Set the channels to download by loading the register B (;B) with a number which binary contents reflect the channel to download: 1 downloads channel zero; 3 downloads ch zero and one; 7 download channel Zero, one and two; 255 download all possible channels.
3. Input the Archive name to download (short name in register A previously obtained by the "F" command).
4. Set the time window to be download by loading its time in seconds in register C, if register C is zero all Archive will be downloaded
5. Open the "save text on file" option on the terminal program.
6. Issue the command D.
7. At the end close the "save text on file" option on the terminal program.
8. Erase the data logger memory only if required as further acquisitions will be stored under separate archives.

Read inputs in real time

1. PGA (programmable gain amplifier) values must have been set by the command G. The default factory value is amplification 1.
2. Type the channel to be read 0-5, 8-13 (register A) and issue the command I

PC and connectivity

Using sensors and external devices

We recommend to take the maximum care when changing connections or assembling external cables or connections, as a mistake can irreparably damage the data logger.

The data logger is provided with a screw connector that can be used for connecting the custom sensors.

Note also that the maximum voltage applicable to the analog inputs is 15 Volt, so applying a greater voltage to the inputs may also damage the data logger, **(no voltage greater than 3.3V can be applied to the digital inputs)**. Applying a voltage greater than the supply voltage to an input channel can also affect the measurements taken from the others.

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Connecting Passive Sensors

Connecting Active Sensors
Differential inputs operate up to ±10V referred to ground.
The negative input must be connected at the closest point near the negative source of signal (sensor ground).

Connecting Switches or Digital Outputs
Switches can be connected to the digital inputs of the data logger. Switches must connect the terminal to ground as digital outputs have a pull-up resistor.
External logic can be connected to the external outputs (pin 6 to pin 11).
The reset value of the portB which controls most of the digital outputs is controlled by location 27 (4123) of EEPROM of which bit controls respective the port output (RB0-RB5)
The command M can be used to change the default value (this value cannot be 255).

Connecting a Relay
A small 12 V relay can be connected between 'SSR control' (pin 16) terminal and 12V positive a diode must be connected in parallel with the relay coil.

External Trigger
External trigger is possible by upgrading the firmware with custom one designed for triggering

## Hardware Connections

TTL serial (USB cable)
1. Serial TTL (3.3V) RX
2. Serial TTL (3.3V) TX
3. NC
4. GND 0V Negative
5. +3.3V Out

General 20 pin Connector
power supplier, modem and controls
RS 232 Serial Port
1. GND
2. RS232 RX
3. RS232 TX

4. NC
5. RA1 (one second timer output)
6. RB0 (default output) external MOSFET driver: set by the user
7. RB1 (default output) external MOSFET driver: set by the user
8. RB4 (default output) external MOSFET driver: can go low at fast sampling time)
9. RB2 (default output) external MOSFET driver: set by the user
10. RB5 (default output) external MOSFET driver: can go low at fast sampling time)
11. RB3 (default output) external MOSFET driver: set by the user
12. RB6 (default input)   reset factory configuration if grounded during boot.
13. Reset (when grounded)
14. RB7 (default input)   debug input do not use
15. 3.3V + supply input Digital Section
16. control output for external SSR
17. NC
18. 5.1V+ supply input Analog Section +5.1V 15 ma
19. Analog GND
20. Oscillator/Clock reference input (5V TTL compatible)

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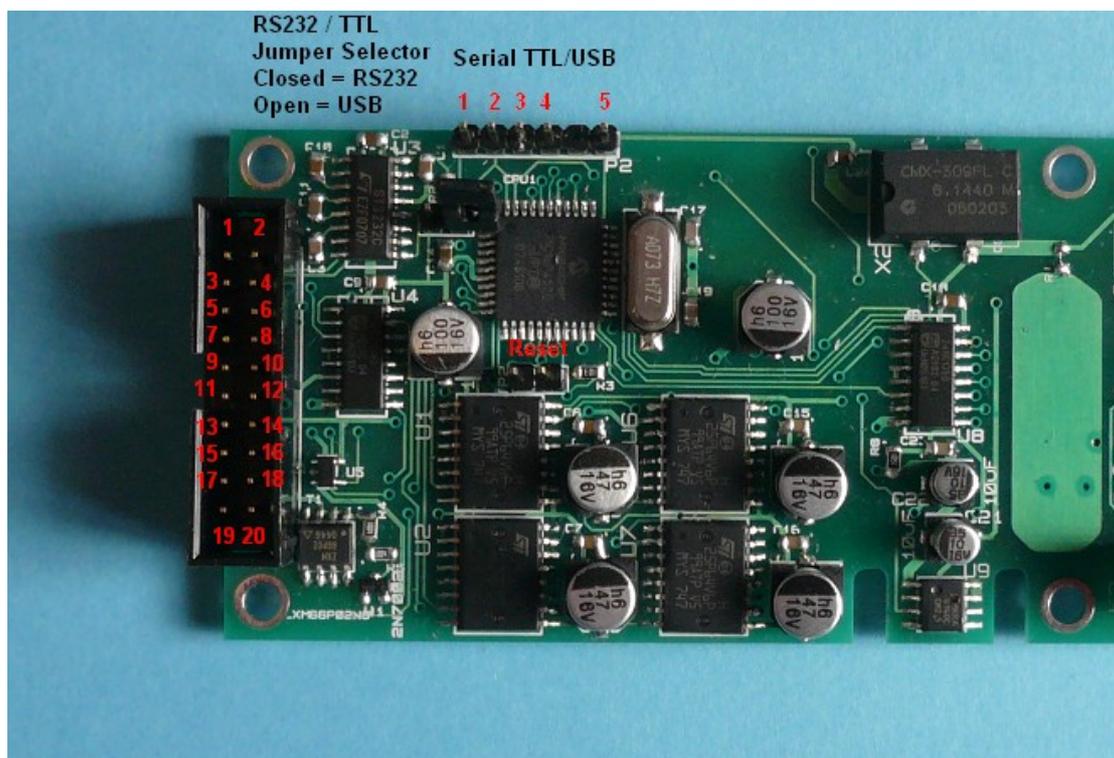
All above ports are TTL 3.3V
Signals according Microchip ® © specifications.
Note RB6 is reserved by firmware for resetting factory values. RB7 is also reserved.

ADC Modules (each single one x 6)

1. Input 0 (-) F
2. Analog Ground
3. Input 0 (+) F
4. Input 1 (-) S
5. Analog Ground
6. Input 1 (+) S

Ch 0	Ch 8
Ch 1	Ch 9
Ch 2	Ch 10
Ch 3	Ch 11
Ch 4	Ch 12
Ch 5	Ch 13
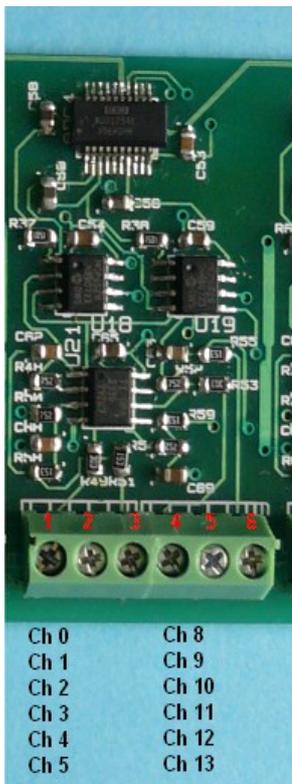
F = high frequency antialiasing filter, S = low frequency antialiasing filter.

Reset
A small jumper is located inside the data logger board. This is the reset : if shorted, the data logger stops sampling, clears all registers and waits for a command.
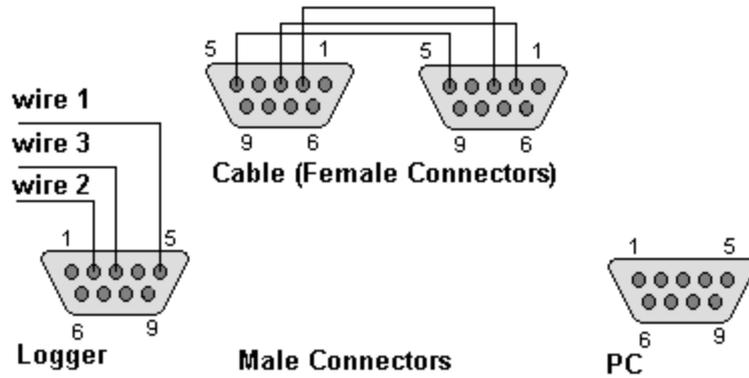
RS232 Connections:
In this example a 9 pin male connector is used to connect a PC to the logger board via a crossed cable (made of two 9 pin female connectors with pin 5 to pin 5; pin 3 to pin 2; and pin 2 to pin 3).

Wire 1 is the GND -> pin 5 of RS232 9 pin connector
Wire 2 is Data RX -> pin 2 of RS232 9 pin connector
Wire 3 is Data TX -> pin 3 of RS232 9 pin connector

Memory Structure

The memory of the data logger is constituted of SPI Flash, CPU EEprom and RAM.
There are 2 registers to store the output of commands (B, C) plus the main register A that stores the numeric data received from the terminal and returns important data obtained from the last command.

SPI Flash Memory can hold pages of data. One page stores fifteen 16 bit synchronous measurements of all 8 (possible) channels plus timestamp and archive name.
The registers are RAM registers, so it means that if you remove the battery or reset the data logger then all contents are cleared to zero.
A section of EEprom CPU memory is used to store permanent constants and settings like serial port speed and sampling rates, so data is retained even when the battery is removed.

Register A is used to retrieve data from other registers, to print it on the terminal or to program other registers or functions. When numerical data is sent to the data logger it is loaded directly to register A.
Other registers are:
B and C which are used for set further command instructions and to return additional values;
N serial port baud rate and pacing;
P number of pages to be scanned at fast rate;
R Scan rate in seconds for fast continuous acquisition;
S Scan rate in seconds for slow acquisition;
T timer in seconds (roll over at 16 bit 65536),
U upper timer (increments at T roll over);
V decimation factor divides the maximum acquisition speed of 16KHZ);
W wake-up time when to start to scan;
X upper part of W (32bit);
Y and Z 32bit millisecond unit timer: increments at: (reference clock)/8192.

T is the first part of the timer, which is incremented every second, and resets to zero when it reaches 65536.
U is the second part of the timer, which is incremented when T reaches 65536 and resets to zero.

DOS/Unix routines use time in this format and exactly refer to the number of seconds from 00:00 of 1-1-1970 as record of the current date (definitions of time.h).

Flash page

A page of SPI flash can store 15 measures at 16 bit resolution or 10 measures at 24 bit resolution. (24 bit by firmware upgrading).
The first 16 bytes are identifiers and timestamps. These 16 bits are subdivided as follow: the first 8 byte are the archive name, the next 4 bytes are the seconds and the last 4 bytes the time units after the seconds: second/230400.
The data is stored as an image rotated by 90 degrees: the first byte contains all MSBits for all synchronous channels (bit 0 = channel zero) and so on. After 16 bytes (24) the next synchronous data point is stored.

Commands

Commands can be issued to the data logger by the terminal.

Commands are constituted by a single character (<u>high case</u>), but sometime a sequence of more characters is required to issue the command properly.

Once a command has been issued it is immediately executed, so the back key (<-) cannot erase the character you have just typed.

<u>Commands use numeric contents of the registers to allow multiple choices to the user, so each bit of the binary representation of those numbers controls a specific operation. For example: the number 254 can be seen as the binary 11111110, so there are 8 bits: the first bit is reset to zero and the last seven bits are set to one.</u>

Some commands have reverse/secondary effects if a semicolon ";" is sent before them.

A
The command "A" erases the register A by loading zero into it.
This command is also used to load a value into register A for example A1234 will load 1234 into register A.
Note: Numbers are loaded to register A with the following internal procedure: any time a figure is sent/received the contents of A are multiplied by 10 and the figure is added to the result.

B
The command "B" copies the contents of the register B to the register A. If you type a semicolon before ";B" then the operation is reversed: the contents of A are copied to B.

C
The command "C" copies the contents of the register C to the register A. If you type a semicolon before ";C" then the operation is reversed: the contents of A are copied to C.

D
The command "D" downloads an archive from the Flash memory to the terminal. It breaks down the contents of the memory in columns by using the value stored in B.
The archive name (numeric short), must be stored in A. Use the command F to see which short archive names are stored into the memory. Usually 2 archives are produced: one for slow acquisition and another one for fast acquisition.
The archive can be seen as a collection of pages (subfiles) and data can be accessed by the time of acquisition.
The value contained in register C enables the time window selective download.
This is the time in seconds corresponding to when a specific window of samples was started to be acquired and may be stored in C.
If C is zero all contents of archive will be downloaded and no selective time download will be done.
Before downloading load B with the correct formatting value: bits 0-7 of register B when set to 1 force the download of the channel corresponding to the specific bit, bit 8 (set to 1) forces the timestamps to be omitted, bit 9 (set to 1) forces the number to be positive only (unsigned integer, negative numbers will be values between 32768 and 65535) , bit 10 (set to 1) forces the download to be page by page with final CRC byte, bit 11 (set to 1) forces the logger to transmit a termination character EOF (0XFF, 255 decimal) upon completion of the download.

Example: "A63;B" sets for the download of 6 channel with page timestamps.
Example: "A15;B" sets for the download of 4 channel with page timestamps.
Example: "A319;B" sets for the download of 6 channel without page timestamps.

Example: "A271;B" sets for the download of 4 channel without page timestamps.
These commands have different effects when a semicolon is typed/sent before them: the data is downloaded as binary. Each memory point is transmitted as 2 bytes (MSB first), and columns are ignored.
Page timestamps are hexadecimal sequences: 8 bytes for the timestamps, 4 bytes for for the seconds and 4 bytes for the time units elapsed from the second (each time unit is 1/230400 seconds).

0000000000010002 00000C95 00000070
Archive name   seconds   time units
(The first byte of the Archive name is the logger number, the second and third the Archive identifier Archive name short, the other bytes are archive counters)

The CRC byte is the XOR product of all bytes of the page. When bit 10 of register B is set the logger waits to receive acknowledge before proceeding with the next page. If this bit is set the client software after receiving the CRC byte must send the character ACK (ASCII 6) to proceed with the next page or the character NAK (negative acknowledge ASCII 21) to download the current page again.

E
The command "E" displays/erases the memory of the data logger.
Typing "E" will display the memory contents.
Typing ";E" will erase all the memory contents.
It can take up to 80 seconds to erase all the memory. Please be patient, as the message done will be displayed upon completion of the operation.

F
The command "F" shows the Archives of the memory, Archives have a 8 byte identifier and contain pages, each page has 8 additional bytes for identification. Archives can be seen as collection of data (timestamped pages) acquired between the issuing of the command start acquisition < and stop acquisition >. A 16 bit value identifying an Archive is displayed (Archive name short), this value will be required for the download.
Register A will be loaded with the first Archive name short that will be found.

G
Command "G" gain sets the PGA (programmable gain amplifier) there are ten PGA amplifiers on the board (channels 12 and 13 have ±10V input only).
There are 8 possible gain values 1,2,4,5,8,10,16,32
Each gain value has a respective code value as per the below table

code	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*
gain	1	2	4	5	8	10	16	32

Enter the channel to set in register B (0-5 Fast) (8-11 Slow) and the code value in register A then issue the command G
Example: the string of commands A8;B A3G sets a gain of 5 on channel 8 (the first of the slow channels).

H
The command "H" (halt) halts the download and acquisition.

I
The command "I" (input) gets a a measure in real time from the inputs of the logger
The Input to be read (0-5 fast) or (8-12 slow) must be in the register A before the typing I, example: A3I reads the channel 3, A I reads channel zero.
Before issuing "I" set the input amplification by entering the selection in register A and issuing the command "G" (please see above).

Value is also returned in register A and B, the output is 24 bit and register B stores the LSB.

J

The command "J" dumps data from Flash. Register A specifies the number of bytes, registers B and C the address. The upper part of register C specifies the chip number: 0, 256, 512, 768.
If you type a semicolon before ";J" then this command downloads the headers (file name and timestamp) for each page of all memory chips, register A specifies the number of page headers to be downloaded.

K

The command "K" (kilobyte) displays the length of a Archive in kilobytes. Enter the short Archive name in register A and then type K. The length is displayed on the terminal and register C is loaded with the 2 last LSB of the length in pages (KB/4).

L

The command "L" cause the system to latch and unlatch the outputs. There are 9 separate outputs (0 - 8) that can be set and reset by this command.
Type the number of the output and then L to set and ;L to reset example "AL" sets the SSR control latched to ground "A;L" resets (off) the SSR control (floating output) A1L sets the first output (RB0) "A2L" sets the second output (RB1) if semicolon is pressed/sent before L the the respective output is reset to zero.
Output four and five can be turned off at acquisition time, to enable this feature type A7L for output four and A8L for output five "A;7L" and "A;8L" respectively disable this feature.
Reset values of those ports can be changed by using the command M
The SSR control is controlled by location 4122 (32 = on, connected to ground) (0= off, open) (255=off).
The other outputs RB0 to RB5 are controlled by location 4123, the each bit sets the respective output.

AL (close SSR)	A;L(open SSR)
A1L (set RB0)	A1;L (reset RB0)
A2L (set RB1)	A2;L (reset RB1)
A3L (set RB2)	A3;L (reset RB2)
A4L (set RB3)	A4;L (reset RB3)
A5L (set RB4)	A5;L (reset RB4)
A6L (set RB5)	A6;L (reset RB5)
A7L (enable flag that will reset RB4 at sampling time)	A7;L (disable flag that will reset RB4 at sampling time)
A8L (enable flag that will reset RB5 at sampling time)	A8;L (disable flag that will reset RB5 at sampling time)

CPU Port	RB0	RB1	RB2	RB3	RB4	RB5
Output	1	2	3	4	5	6

M

The command "M" recalls and writes the contents of the Ram, Eeprom. (this command is dangerous, do not use it). Memory is mapped from 0 to 4095 and eeprom from 4096 to 4159, register B must be loaded with the address and A returns or write the value "M" returns the contents of the memory location and ";M" write the contents of register A to the memory location pointed by register B.
This command can be also use to set the reset parameters for the CPU ports
the locations of these parameters start from location 4122 for portA to 4126 for portE

If the value of these eeprom locations is 255 then the respective port is not loaded and its value is left to its firmware default value.
Example the following commands set the CPU to start with the SSR control latched
A4122;B
points to portA
A32;M
write 32: (RA5) on on start-up will be on.

N
The command ";N" sets the baud rate and pacing for the communication port. Register A will contain a 16 bit value composed by two bytes: the LSB is the baud rate divisor 15= 115200, 191 = 9600. Formula -> baudrate = 1843200/(1+divisor)
The upper byte (default 16) is the port pacing (small delay between one byte and the next) to be used if the terminal is too slow and cannot cope with all characters sent by the logger.
N is a register and can be set ";N" and retrieved "N" as any other register.
"A4111;N" sets on 115200 baud and a pace of 10
"A4287;N" sets on 9600 baud and a pace of 10

O
The command "O" opens a SPI hardware peripheral (memory, PGA) pointed by register A.
If you type a semicolon before ";O" then the peripheral will be closed.
This command require one to know the hardware in detail and if improperly used can put the Flash memory in a read only protect mode which would require special commands to be reversed.

P
The command "P" copies the contents of the register P to the register A. P is the number of pages to be acquired in high speed acquisition (usually 134: times 15 = 2010 samples). If you type a semicolon before ";P" then the operation is reversed: the contents of A are copied to P.
If page register is zero no acquisition is done.

Q
The command "Q" transfers the contents of register A to the hardware SPI peripheral opened by command "O", the command also retrieves a byte from the peripheral (if available).
This command require one to know the hardware in detail and if improperly used can put the Flash memory in a read only protect mode which would require special commands to be reversed. This command can be used to write external software applications able to direct access the flash memory or PGAs.

R
The command "R" copies the contents of the register R to the register A. R is the scan rate for the high speed acquisition windows (usually 60 seconds). If you type a semicolon before ";R" then the operation is reversed: the contents of A are copied to R.
If register is zero no acquisition is done.

S
The command "S" copies the contents of the register S to the register A. S is the scan rate for the low speed acquisition (usually 1 second). If you type a semicolon before ";S" then the operation is reversed: the contents of A are copied to S.
If register is zero no acquisition is done.

T
The command "T" copies the contents of the register T to the register A, T is the first part of the timer register. If you type a semicolon before ";T" then the operation is reversed: the contents of A are copied to T.

U

The command "U" copies the contents of the register U to the register A, U is the second part of the timer register. If you type a semicolon before ";U" then the operation is reversed: the contents of A are copied to U.

V

The command "V" copies the contents of the register V to the register A, V is a decimation counter register as it divides the acquisition base frequency of 16 KHZ (usually V is 4 = 4KHZ). If you type a semicolon before ";V" then the operation is reversed: the contents of A are copied to V.

W

The command "W" copies the contents of the register W to the register A, W is the first part of the "Wake up" register. If you type a semicolon before ";W" then the operation is reversed: the contents of A are copied to W.

X

The command "X" copies the contents of the register X to the register A, X is the upper part of the "Wake up" register. If you type a semicolon before ";X" then the operation is reversed: the contents of A are copied to X.

Y

The command "Y" copies the contents of the register Y to the register A, Y is a pseudo millisecond register it increments approximatively each millisecond. If you type a semicolon before ";Y" then the operation is reversed: the contents of A are copied to Y.
Writing to this register may cause the system to stop counting time.

Z

The command "Z" copies the contents of the register Z to the register A, Z is the upper part of the pseudo millisecond register Y. If you type a semicolon before ";Z" then the operation is reversed: the contents of A are copied to Z.
Writing to this register may cause the system to stop counting time.

:

The command ":" causes the data logger to retrieve or store (;:) the current configuration permanently (all register N, P, R, S, V and Archive names).

;

The command ";" usually reverses the effect of a command or enables extended features of the command itself (example: read becomes write)

<

The command "<" causes the data logger to start the acquisition at given time (registers W and X). The semicolon causes the command ";<" to start the acquisition immediately.
 This command also increments the Archive names stored within the RAM and EEPROM

>

The command ">" causes the data logger to stop the acquisition.

=

The command "=" is the synchronisation command it resets the internal current microsecond counter. After issuing this command the contents of A are added to the counter (note that A becomes a 24 bit register for this command and can be loaded with a number up to 230499 before issuing this command).
This value of 230500 represents one second, when this counter reaches 230500 the internal register "T" (timer of seconds) is incremented by one.

If the semicolon is typed before this command ";=" the contents of register B are transferred to T and and contents of register C are transferred to register U . If A, B, C are loaded with zero the the command ";=" will reset all system to zero time.

?

The command "?" causes the data logger to dump eeprom values. ";?" will dump all RAM to the screen.

@

The command "@" causes the data logger to print the numeric value of the register A to the terminal this value is 16 bit (0-65535) but the register A can be loaded with numbers up to 655359.

Troubleshooting

data logger does not echo commands on terminal once connected:

> You are typing low case characters: Use <u>capital ones.</u>

Technical specifications

Please note that specifications can change without notice.

Appendix

Command Quick List

Command	Description	Command	Description
A	Erase register A		
B	B copied to A or retrieved ;		
C	C copied to A or retrieved ;		
D	Download Memory (,D binary)		
E	Show/ Erase memory (E)(;E)		
F	Archive length (Archive name in A)		
G	PGA Gain B = channel A = gain code		
H	Halt	:	Retrieve/save configuration
I	Get measure A = channel	;	Reverse effect (write)
J	Dump SPI Flash, Dump Flash Header	<	Start acquisition
K	Kilobytes Archive length (Archive name in A)	=	Synchronisation
L	Latch output	>	End acquisition
M	Read/Write register A to memory	?	Dump CPU memory
N	Baud rate	@	Print register A contents at (16 bit)
O	Open the SPI peripheral (A) ;close		
P	Pages per window		
Q	Write A to SPI peripheral open by O		
R	Rate fast seconds		
S	Rate Slow seconds		
T	Timer		
U	Upper Timer		
V	Velocity (decimator)		
W	Wake up		
X	Wake up		
Y	Fast Timer		
Z	Upper part, resets every 64 seconds		

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