

**openC<sup>4</sup>D**

# **Serine Protocol Communication Manual**

**Version 3**

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## Introduction

The hardware was conceived using a Teensy 2.0 allowing up to four capacitively coupled conductivity detectors (C<sup>4</sup>Ds). The detectors are numbered from 0 to 3. The communication with the openC<sup>4</sup>D is allowed through a serial port over USB.

The command Connect allows establishing a connection with the detector. When connected, a continuous mode of transmission of the ADC data is possible. In this case, the user does not need to ask for each new ADC value, because they are sent continuously.

The transmission mode is established by the Set command. This command also allows choosing the format of the data sending back to the user. It is possible configure the answer as a formatted data (according Serine Protocol), or a simple ASCII line (one-way Serine), which allows data acquisition without a Serine front end.

According to the Serine Protocol, the ID may be changed by the command “Ix”. In this case, the new ID must be used instead of the default ID ‘d’. For sake of simplicity, in this manual, the other virtual device exchanging messages is always ‘m’. However, in real communication this character should be replaced by the valid ID of the virtual device that is communicating with the detector.

The “\0” at the end of each message is just to remember that an additional position with a null character (ASCII code 0) at the end of the array is needed for most of the program languages (such as C, C++, Java, etc.). However, it is not part of the Serine Protocol.

## Commands

### Identification

This command allows get the ID of the virtual device as well as to change it.

#### Command string:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
d	m	I	;	\0																												

#### Return string:

0	1	2	3	4																												
m	d	i	y	s	...	s	;	\0																								

y – ‘t’ means that the following string (s...s) is a temporary identification; ‘P’ means that the following string (s...s) is a proprietary identification; ‘S’ means that the following string (s...s) is a valid ID provided by Serine Identification Service (SIS). Other character may be used by other public providers of identification service.

#### Change – command string:

0	1	2	3	4	5																											
d	m	I	x	y	s	...	s	;	\0																							

y – is the new ID to be adopted by the detector if the following string (s...s) is equal to its identification string. If the ID is changed, all the other messages exchanged with this device must use it instead of the default ID ‘d’.

#### Examples:

Sender	This device	Comment
dmI;	mdit_just_a_test;	The device has a temporary identification “t_just_a_test”
dmI;	mdiSdL012042;	The device is the SIS virtual device dL01, version 2, serial number 042.
dmIxwSdL012042;		The device identified with “SdL012042” has now the ID <b>w</b> instead of <b>d</b> ;

## Connect

This command allows establishing a connection and warning the detector that the listener is ready to get data continuously.

### Command string:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
d	m	X	y	;	\0																											

### Return string:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
m	d	x	y	;	\0																											

y – 'N' means connection is ON; 'F' means connection is OFF.

### Examples:

Sender	This device	Comment
dmXN;	dmxN;	The detector recognized the connection.
dmXF;	dmxF;	The connection was turned off.

## Zero

This command reinitiates the chronometer.

### Command string:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
d	x	Z	;	\0																												

## Set

This command configures the way the command Get will work. See command Get for more information.

### Command string:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
d	m	S	y	t	a <sub>0</sub>	a <sub>1</sub>	a <sub>2</sub>	a <sub>3</sub>	;	\0																						

Position:

y – 'f' set the output to send back Serine-formatted data. Any other character indicates to operate in the one-way Serine, and this character will be used as a separator.

The only exceptions are 't' standing for tab and 's' standing for space. Any valid Serine character can also be used.

$t$  – 'l' indicates that a *time stamp* should be included in the ASCII string.

$a_x$  – 'l' indicates that the data from ADC  $x$  should be included in the response.

## Get

This command instructs the virtual device to send back the values of the A/D converters. It is possible to put the virtual device in a continuous mode sending each new value obtained from the ADCs, as well as to instruct about the data format.

### Command string:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
d	m	G	y	;	\0																											

$y$  – 'r' sets the continuous mode; 'h' halts the continuous mode; 'w' waits for the external start; 't' waits for the external start and stop; 'S' requests the status. Any other option will result in just one instantaneous get.

### Return string for option 'f' (Serine formatted):

Return string for option 1 (same formatted):																																
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
m	d	g	y	t	t	t	t	t	t	t	a <sub>w</sub>	a <sub>w</sub>	a <sub>w</sub>	a <sub>w</sub>	a <sub>w</sub>	a <sub>w</sub>	a <sub>w</sub>	a <sub>x</sub>	a <sub>x</sub>	a <sub>x</sub>	a <sub>x</sub>	a <sub>x</sub>	a <sub>x</sub>	a <sub>x</sub>	a <sub>x</sub>	;	\0					

$y$  – 'A' means the first block of detector (ADCs 0 and 1); 'B' means the second block of detector (ADCs 2 and 3).

$t$  – time in milliseconds (seven digits).

$a_w$  a  $a_z$  – readings (from 0 to 4,194,304) of the ADCs 0 and 1, for  $y$  = 'A', or 2 and 3, for  $y$  = 'B'.

### Return string for status request (for Serine formatted option only):

Return string for status request (for binary formatted option only).																																
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
m	d	g	S	x	y	z	;	\0																								

$x$  – 'T' means that the detector is in the continuous mode.

$y$  – 'T' means that the detector is waiting for an external start pulse.

$z$  – 'T' means that the detector is waiting for an external stop pulse.

### Return string for one-way Serine in command Set:

Return string for one way service in command set:																															
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																
$a_x$	$a_x$	$a_x$	$a_x$	$a_x$	$a_x$	$a_x$	$s$	$a_y$	$a_y$	$a_y$	$a_y$	$a_y$	$a_y$	$a_y$	$s$	...	$a_z$	$a_z$	$a_z$	$a_z$	$a_z$	$a_z$	$a_z$	$a_z$	lf	\0					

$a_x$  to  $a_z$  – time and/or ADC readings according to the command Set.

$s$  – separator according command to the command Set.

lf – ASCII line feed.

Examples:

Master	This device	Comment
dmSs10011;dmZ;dmGr;	0000025 2153341 2271077 0000108 2153334 2271096 0000174 2153356 2271103 0000256 2153305 2271093 0000323 2153342 2271082 0000391 2153334 2271080 0000473 2153366 2271080 0000541 2153307 2271102 0000609 2153354 2271090 0000691 2153345 2271086 ...	The detector was configure to answer as one-way Serine, with spaces to separate columns, the first column is the time in milliseconds followed by the readings of detectors 2 and 3. The chronometer is initiated, and a continuous reading mode is initiated.
dmGh;		The data transmission is stopped.

Master	This device	Comment
dmSf10011;dmZ;dmGr;	mdgB0000063215338222 71005;mdgB00001372153 3682270994;mdgB000020 921533672270994;mdgB0 00028521534102270967; mdgB0000356215338222 71006;mdgB00004302153 3462270993;mdgB000050 221533712270980;mdgB0 00057621533752270974; mdgB0000651215336322 70980; ...	The readings of the detectors 2 and 3 (block B) will be returned in Serine-formatted strings. The chronometer is initiated, and a continuous reading mode is initiated.
dmGh;		The data transmission is stopped.