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OT Bioelettronica

Quattrocento
Configuration protocol – v1.5

To configure the bioelectrical signal amplifier quattrocento it is necessary to provide a command string composed by 40 bytes. The string sets the acquisition parameters and the detection mode of every input.

The 40 bytes are listed in the following table:

Seq. Num.	**BYTE NAME**	**DESCRIPTION**
1	ACQ_SETT	Sampling frequency, number of channels, start/stop acquisition, start/stop recording
2	AN_OUT_IN_SEL	Select the input source and gain for the analog output
3	AN_OUT_CH_SEL	Select the channel for the analog output source
4, 5, 6	IN1_CONF0/1/2	Configuration for the eight IN inputs: high pass filter, low pass filter, detection mode, muscle, side, sensor and adapter
7, 8, 9	IN2_CONF0/1/2	
10, 11, 12	IN3_CONF0/1/2	
13, 14, 15	IN4_CONF0/1/2	
16, 17, 18	IN5_CONF0/1/2	
19, 20, 21	IN6_CONF0/1/2	
22, 23, 24	IN7_CONF0/1/2	
25, 26, 27	IN8_CONF0/1/2	
28, 29, 30	MULTIPLE_IN1_CONF0/1/2	Configuration for the four MULTIPLE IN inputs: high pass filter, low pass filter and detection mode, muscle, side, sensor and adapter
31, 32, 33	MULTIPLE_IN2_CONF0/1/2	
34, 35, 36	MULTIPLE_IN3_CONF0/1/2	
37, 38, 39	MULTIPLE_IN4_CONF0/1/2	
40	CRC	Eight bits CRC

Detail about each byte are provided in the following pages.

ACQ_SETT BYTE description:

1	DECIM	REC_ON	FSAMP1	FSAMP0	NCH1	NCH0	ACQ_ON

bit 7 **= 1:** Fixed

bit 6 **DECIM:** Decimator

1 = The decimator is active. The required sampling frequency is obtained by sampling all the signals at 10240 Hz and then sending one sample out of 2, 5 or 20, to obtain the desired number of sample per second.

0 = The decimator is not active. The required sampling frequency is obtained by sampling the signals directly at the desired sampling frequency.

bit 5 **REC_ON:** Recording on bit. If the Trigger OUT has to be used to synchronize the acquisition with other instruments, the recording has to be started when the trigger channel has a transition. I other words is the quattrocento that generate a signal indicating to the computer when the data has to be recorded. To start this procedure the REC_ON bit has to be set:

1 = The user wants to start an acquisition associated with the Trigger OUT

0 = The user wants to stop an acquisition associated with the Trigger OUT

bit 4-3 **FSAMP<1:0>:** Sampling frequency selection bits:

11 = sampling frequency is set to 10240 Hz

10 = sampling frequency is set to 5120 Hz

01 = sampling frequency is set to 2048 Hz

00 = sampling frequency is set to 512 Hz

bit 2-1 **NCH<1:0>:** Channel setting bits:

11 = all inputs are active

10 = IN1 to IN6 and MULTIPLE IN 1 to MULTIPLE IN 3 are active

01 = IN1 to IN4, MULTIPLE IN 1 and MULTIPLE IN 2 are active

00 = IN1, IN2 and MULTIPLE IN 1 are active

In all the configuration additional eight channels with accessories information are transferred. See the end of this document for details.

bit 0 **ACQ_ON:** Acquisition on bit:

1 = data sampling and transfer is active

0 = data sampling and transfer is not active

AN_OUT_IN_SEL BYTE description:

0	0	ANOUT_GAIN1	ANOUT_GAIN0	INSEL3	INSEL2	INSEL1	INSEL0

bit 7 **= 0:** Fixed

bit 6 **= 0:** Fixed

bit 5-4 **ANOUT_GAIN<1:0>:** Gain for the analog output:

11 = the analog output is 16

10 = the analog output is 4

01 = the analog output is 2

00 = the analog output is 1

bit 3-0 **INSEL<3:0>:** Source input for analog output select bits:

1100 = the analog output signal came from AUX IN

1011 = the analog output signal came from MULTIPLE IN4

1010 = the analog output signal came from MULTIPLE IN3

1001 = the analog output signal came from MULTIPLE IN2

1000 = the analog output signal came from MULTIPLE IN1

0111 = the analog output signal came from IN8

0110 = the analog output signal came from IN7

0101 = the analog output signal came from IN6

0100 = the analog output signal came from IN5

0011 = the analog output signal came from IN4

0010 = the analog output signal came from IN3

0001 = the analog output signal came from IN2

0000 = the analog output signal came from IN1

AN_OUT_CH_SEL BYTE description:

0	**0**	**CHSEL5**	**CHSEL4**	**CHSEL3**	**CHSEL2**	**CHSEL1**	**CHSEL0**

bit 7 **= 0:** Fixed

bit 6 **= 0:** Fixed

bit 5-0 **CHSEL<5:0>:** Source channel for analog output select bits:
Considering the input selected by the AN_OUT_IN_SEL byte, this number indicates which channels of that input have to be provided at the ANALOG OUT BNC on the rear panel.
NOTE: 0 indicates the first channel, 1 the second channel etc…

INX_CONF0 and MULTIPLE_INX_CONF0 BYTE description:

0	**MUS6**	**MUS5**	**MUS4**	**MUS3**	**MUS2**	**MUS1**	**MUS0**

bit 7 **= 0:** Fixed

bit 6-0 **MUS<6:0>:** Muscle index for the input INX or MULTIPLE INX:

0	Not defined	25	Ext. Carpi Ulnaris	50	Soleus
1	Temporalis Anterior	26	Ext. Dig. Communis	51	Semitendinosus
2	Superfic. Masseter	27	Brachioradialis	52	Gluteus maximus
3	Splenius Capitis	28	Abd. Pollicis Brev.	53	Gluteus medius
4	Upper Trapezius	29	Abd. Pollicis Long.	54	Vastus lateralis
5	Middle Trapezius	30	Opponens Pollicis	55	Vastus medialis
6	Lower Trapezius	31	Adductor Pollicis	56	Rectus femoris
7	Rhomboideus Major	32	Flex. Poll. Brevis	57	Tibialis anterior
8	Rhomboideus Minor	33	Abd. Digiti Minimi	58	Peroneus longus
9	Anterior Deltoid	34	Flex. Digiti Minimi	59	Semimembranosus
10	Posterior Deltoid	35	Opp. Digiti Minimi	60	Gracilis
11	Lateral Deltoid	36	Dorsal Interossei	61	Ext. Anal Sphincter
12	Infraspinatus	37	Palmar Interossei	62	Puborectalis
13	Teres Major	38	Lumbrical	63	Urethral Sphincter
14	Erector Spinae	39	Rectus Abdominis	64	Not a Muscle
15	Latissimus Dorsi	40	Ext. Abdom. Obliq.		
16	Bic. Br. Long Head	41	Serratus Anterior		
17	Bic. Br. Short Head	42	Pectoralis Major		
18	Tric. Br. Lat. Head	43	Sternoc. Ster. Head		
19	Tric. Br. Med. Head	44	Sternoc. Clav. Head		
20	Pronator Teres	45	Anterior Scalenus		
21	Flex. Carpi Radial.	46	Tensor Fascia Latae		
22	Flex. Carpi Ulnaris	47	Gastrocn. Lateralis		
23	Palmaris Longus	48	Gastrocn. Medialis		
24	Ext. Carpi Radialis	49	Biceps Femoris		

INX_CONF1 BYTE description:

SENS4	**SENS3**	**SENS2**	**SENS1**	**SENS0**	**ADAPT2**	**ADAPT1**	**ADAPT0**

bit 7-3 **SENS<4:0>:** Muscle index for the input INX or MULTIPLE INX:

0	Not defined	8	4 el. Array 10mm	16	16 el. Array 5mm
1	16 Monopolar EEG	9	8 el. Array 5mm	17	16 el. Array 10mm
2	Mon. intram. el.	10	8 el. Array 10mm	18	16 el. Array 10mm
3	Bip. el - CoDe	11	64el. Gr. 2.54mm	19	16 el. rectal pr.
4	8 Acceleromet.	12	64 el. Grid 8mm	20	48 el. rectal pr.
5	Bipolar el. - DE1	13	64 el. Grid 10mm	21	12 el. Armband
6	Bipolar el. - CDE	14	64 el.Gr. 12.5mm	22	16 el. Armband
7	Bip. el. - other	15	16el.Array 2.5mm	23	Other sensor

bit 2-0 **ADAPT<2:0>:** Muscle index for the input INX or MULTIPLE INX:

0	Not defined	3	4ch AD4x4	6	Other
1	16ch AD1x16	4	64ch AD1x64	7	
2	8ch AD2x8	5	16ch AD8x2	8	

INX_CONF2 BYTE description:

SIDE1	SIDE0	HPF1	HPF0	LPF1	HPF0	MODE1	MODE0

bit 7-6 **SIDE<1:0>:** Side index for the input INX or MULTIPLE INX:

11 = None

10 = Right

01 = Left

00 = Not defined

bit 5-4 **HPF<1:0>:** High pass filter index for the input INX or MULTIPLE INX:

11 = 200 Hz

10 = 100 Hz

01 = 10 Hz

00 = 0.3 Hz

bit 3-2 **LPF<1:0>:** Low pass filter index for the input INX or MULTIPLE INX:

11 = 4400 Hz

10 = 900 Hz

01 = 500 Hz

00 = 130 Hz

bit 1-0 **MODE<1:0>:** Detection mode index for the input INX or MULTIPLE INX:

10 = Bipolar

01 = Differential

00 = Monopolar

Accessories channels

In addition to the signals acquired from the inputs on the quattrocento front panel and the auxiliary inputs on the back panel, eight accessory channels are transferred from quattrocento to the computer. The accessory channels have a resolution of 16 bits.
The channels content is:

Accessory channel 1: sample counter. It is a number that is incremented at any samples. It has to be considered as an unsigned short, in the range 0 – 65535. It can be used to check if some samples has been lost in the transfer/save process. It is reset at the start of the data transfer and it rollover when reach the maximum value. The first value in a recorded signals depend on the instant when the acquisition is started, it can't be predicted.

Accessory channel 2: trigger channel. This channel is a copy of the TRIGGER BNC state (logical level 0 or 1) on the back panel of quattrocento. It has to be used to start/stop data acquisition synchronously to other devices providing or receiving the trigger signal. In electrically elicited acquisition, if the neuromuscular stimulator provide a trigger signal when a stimulation pulse is produced, the trigger channel can be used to align the signal plot with the stimulation pulses. A value of 0 represent the logical level 0 on the BNC, a value of 31767 represent the logical level 1 on the trigger BNC.

Accessory channel 3: Not used. For future implementations.

Accessory channel 4: buffer usage. It is an indication of the available bytes space in the quattrocento internal buffer. Values close to zero indicate that the buffer is full and sample can be lost if the PC will not read soon data. Buffer full condition happen when data transfer is slow. It can be due to slow computers or slow network adapter, busy network or slow network switch/router.

Accessory channel 5: Not used. For future implementations.

Accessory channel 6: Not used. For future implementations.

Accessory channel 7: Not used. For future implementations.

Accessory channel 8: Not used. For future implementations.