Communication protocol

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1. Serial port parameters

Parameter name	Value
Baudrate	115200
Data bits	8
Parity	Even
Stop bits	1
Flow control	None

2. Brief command list

Command	Code	Sender	Description
Generic commands			
`getFirmwareID`	0x01	PC[1]	Requests the firmware version of embedded system. Also, provides information for the PC app that the system is connected.
Electrochemical Impedance Spectroscopy (EIS) commands			
`takeMeasEis`	0x02	PC[2]	All required parameters are sent from PC to ES in order for ES to start the EIS measurement.
`giveMeasChunkEis`	0x03	ES	ES sends a chunk of measured data to the PC
`endMeasEis`	0x04	ES	After the last chunk of EIS data is sent, ES sends this command in order to close the measurement.
Cyclic Voltammetry (CV) commands			
`takeMeasCv`	0x05	PC	All required parameters are sent from PC to ES in order for ES to start the CV measurement.
`giveMeasChunkC`	0x06	ES	ES sends a chunk of measured data to the PC
`endMeasC`	0x07	ES	After the last chunk of CV data is sent, ES sends this command in order to close the measurement.
Chronoamperometry (CA) commands			
`takeMeasCa`	0x08	PC	All required parameters are sent from PC to ES in order for ES to start the CA measurement.
`giveMeasChunkCa`	0x09	ES	ES sends a chunk of measured data to the PC
`endMeasCa`	0x0A	ES	After the last chunk of CA data is sent, ES sends this command in order to close the measurement.
Differential Pulse Voltammetry (DPV) commands			
`takeMeasDpv`	0x0B	PC	All required parameters are sent from PC to ES in order for ES to start the DPV measurement.
`giveMeasChunkDpv`	0x0C	ES	ES sends a chunk of measured data to the PC
`endMeasDpv`	0x0D	ES	After the last chunk of DPV data is sent, ES sends this command in order to close the measurement.
Square Wave Voltammetry (SWV) commands			
`takeMeasSwv`	0x0E	PC	All required parameters are sent from PC to ES in order for ES to start the SWV measurement.

giveMeasChunkSwv	0x0F	ES	ES sends a chunk of measured data to the PC
endMeasSwv	0x10	ES	After the last chunk of SWV data is sent, ES sends this command in order to close the measurement.

[1] PC – Computer user application,
[2] ES – Embedded system.

3. Extended command list

3.1. getFirmwareID

PC sends getFirmwareID to the embedded system in order to retrieve the current firmware version of the embedded system and also obtain the information about connection. If the firmware version is returned, it means that embedded system is connected. This command should be used as communication initialization command.

Communicate:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Sync Byte	Command	Length 0	Length 1	Length 2	Length 3	CRC 0	CRC 1
‘?’ (0x3F)	0x01	0x02	0x00	0x00	0x00	0xXX	0xXX

Answer:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10	Byte 11
Sync Byte	Command	Length 0	Length 1	Length 2	Length 3	Firmware 0	Firmware 1	Firmware 2	Firmware 3	CRC 0	CRC 1
‘?’ (0x3F)	0x01	0x06	0x00	0x00	0x00	0xXX	0xXX	0xXX	0xXX	0xXX	0xXX

3.2. takeMeasEis

PC sends all required parameters for the EIS measurement to the ES. After ES obtains the command it then checks the parameters. If they are all ok, he sends an ok ACK, if not, he sends an error code ACK.

Communicate:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Sync Byte	Command	Length 0	Length 1	Length 2	Length 3	amplitude	Freq Range Start 0
‘?’ (0x3F)	0x02	0x0E	0x00	0x00	0x00	0-100	0xXX

Byte 8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Freq Range Start 1	Freq Range Start 2	Freq Range Start 3	Freq Range End 0	Freq Range End 1	Freq Range End 2	Freq Range End 3	Freq Range Step 0
0xXX	0xXX	0xXX	0xXX	0xXX	0xXX	0xXX	0xXX

Byte 16	Byte 17	Byte 18	Byte 19
Freq Range Step 1	StepType	CRC 0	CRC 1
0xXX	0-1	0xXX	0xXX

amplitude (Byte 6): Maximum signal amplitude expressed in mili volts, values from 0 to 100 (unsigned char).

FreqRangeStart (Bytes 7-10): The starting frequency of the measurement expressed as float value.

FreqRangeEnd (Bytes 11-14): The ending frequency of the measurement expressed as float value.

FreqRangeStep (Bytes 15-16): Numbers of steps/ measurements to take between the starting and ending frequency.

StepType (Byte 17): 0 – Linear, 1 – Logarithmical.

Answer:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Sync Byte	Command	Length 0	Length 1	Length 2	Length 3	ACK	CRC 0
‘?’ (0x3F)	0x02	0x03	0x00	0x00	0x00	0-1	0xXX

Byte 8
CRC 1
0xXX

ACK (Byte 6): 0 – parameters OK, 1 – parameters invalid, measurement won’t be started.

3.3. giveMeasChunkEis

ES sends measurement results to the PC, for a certain frequency step. This message required no answer.

Communicate:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Sync Byte	Command	Length 0	Length 1	Length 2	Length 3	Real 0	Real 1
‘?’ (0x3F)	0x03	0x0E	0x00	0x00	0x00	0xXX	0xXX

Byte 8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Real 2	Real 3	Imag 0	Imag 1	Imag 2	Imag 3	Freq 0	Freq 1
0xXX	0xXX	0xXX	0xXX	0xXX	0xXX	0xXX	0xXX

Byte 16	Byte 17	Byte 18	Byte 19
Freq 2	Freq 3	CRC 0	CRC 1
0xXX	0xXX	0xXX	0xXX

Real (Bytes 6-9): Real part of measured impedance expressed as float.

Imag (Bytes 10-13): Imaginary part of measured impedance expressed as float.

Freq (Bytes 14-17): Frequency of the signal witch which measurement was taken.

3.4. endMeasEis

ES sends this command to the PC right after the last giveMeasChunk was sent in order to close the measurement process.

Communicate:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Sync Byte	Command	Length 0	Length 1	Length 2	Length 3	CRC 0	CRC 1
‘?’ (0x3F)	0x04	0x02	0x00	0x00	0x00	0xXX	0xXX

Answer:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Sync Byte	Command	Length 0	Length 1	Length 2	Length 3	CRC 0	CRC 1
‘?’ (0x3F)	0x04	0x02	0x00	0x00	0x00	0xXX	0xXX

3.5. takeMeasCv

PC sends all required parameters for the CV measurement to the ES. After ES obtains the command it then checks the parameters. If they are all ok, he sends an ok ACK, if not, he sends an error code ACK.

Communicate:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Sync Byte	Command	Length 0	Length 1	Length 2	Length 3	Start Potential 0	Start Potential 1
'?' (0x3F)	0x05	0x0B	0x00	0x00	0x00	0xXX	0xXX

Byte 8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
End Potential 0	End Potential 1	Number of cycles	Potential step 0	Potential step 1	Scanning speed 0	Scanning speed 1	CRC 0
0xXX	0xXX	0xXX	0x00	0x00	0x00	0xXX	0xXX

Byte 16
CRC 1
0xXX

Start potential (bytes 6-7): The first working signal potential [mV]. Values from -1000 to +1000 (16 bit).

End potential (bytes 8-9): The last working signal potential [mV]. Values from -1000 to +1000 (16 bit).

Number of cycles (byte 10): A number of full measure cycles to make. Values from 1 to 0xFF (8 bit).

Potential step (bytes 11-12): Each measurement step is greater than the last by the factor of Potential step [mV]. When it exceeds End Potential value, the measurement is finished. Values from -1000 to +1000 (16 bit).

Scanning speed (bytes 13-14): Time interval in between which the measurements should be taken [mV/s]. Values from 1 to 0xFFFF (16 bit).

Answer:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Sync Byte	Command	Length 0	Length 1	Length 2	Length 3	ACK	CRC 0	CRC 1
‘?’ (0x3F)	0x05	0x03	0x00	0x00	0x00	0-1	0xXX	0xXX

ACK (Byte 6): 0 – parameters OK, 1 – parameters invalid, measurement won’t be started.

3.6. giveMeasChunkCv

ES sends measurement results to the PC, for a certain potential step. This message required no answer.

Communicate:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Sync Byte	Command	Length 0	Length 1	Length 2	Length 3	Sample number 0	Sample number 1
‘?’ (0x3F)	0x06	0x0C	0x00	0x00	0x00	0xXX	0xXX
Byte 8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Current value 0	Current value 1	Current value 2	Current value 3	Voltage value 0	Voltage value 1	Voltage value 2	Voltage value 3
0xXX	0xXX	0xXX	0xXX	0xXX	0xXX	0xXX	0xXX
Byte 16	Byte 17						
CRC 0	CRC 1						
0xXX	0xXX						

Sample number (bytes 6-7): number of the currently sent sample. Values from 0 to 0xFFFF (16 bit).

Current value (bytes 8-11): Current measurement for a sample. 32 bit float value.

Voltage value (bytes 8-11): Voltage measurement for a sample. 32 bit float value.

3.7. endMeasCv

ES sends this command to the PC right after the last giveMeasChunk was sent in order to close the measurement process.

Communicate:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Sync Byte	Command	Length 0	Length 1	Length 2	Length 3	CRC 0	CRC 1
‘?’ (0x3F)	0x07	0x02	0x00	0x00	0x00	0xXX	0xXX

Answer:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Sync Byte	Command	Length 0	Length 1	Length 2	Length 3	CRC 0	CRC 1
‘?’ (0x3F)	0x07	0x02	0x00	0x00	0x00	0xXX	0xXX

3.8. takeMeasCa

PC sends all required parameters for the CA measurement to the ES. After ES obtains the command it then checks the parameters. If they are all ok, he sends an ok ACK, if not, he sends an error code ACK.

Communicate:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Sync Byte	Command	Length 0	Length 1	Length 2	Length 3	Potential 0	Potential 1
‘?’ (0x3F)	0x08	0x0B	0x00	0x00	0x00	0xXX	0xXX

Byte 8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Measure Time 0	Measure Time 1	Time delta 0	Time delta 1	Time delta 2	Time delta 3	CRC 0	CRC 1
0xXX	0xXX	0xXX	0x00	0x00	0x00	0xXX	0xXX

Potential (bytes 6-7): Set working potential for the measurement [mV]. Values from -1000 to +1000 (signed 16 bit).

Measure time (bytes 8-9): Measure time for the process [s]. Values from 1 to 10000 (unsigned 16 bit).

Time delta (bytes 10-13): Time interval at which each measures will be taken [s]. Values from 1 ms to 10 s (32 bit float, expressed in seconds).

Answer:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Sync Byte	Command	Length 0	Length 1	Length 2	Length 3	ACK	CRC 0	CRC 1
‘?’ (0x3F)	0x08	0x03	0x00	0x00	0x00	0-1	0xXX	0xXX

ACK (Byte 6): 0 – parameters OK, 1 – parameters invalid, measurement won’t be started.

3.9. giveMeasChunkCa

ES sends measurement results to the PC, for a certain time stamp. This message required no answer.

Communicate:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Sync Byte	Command	Length 0	Length 1	Length 2	Length 3	Current value 0	Current value 1
‘?’ (0x3F)	0x09	0x0A	0x00	0x00	0x00	0xXX	0xXX

Byte 8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Current value 2	Current value 3	Absolute time 0	Absolute time 1	Absolute time 2	Absolute time 3	CRC 0	CRC 1
0xXX	0xXX	0xXX	0xXX	0xXX	0xXX	0xXX	0xXX

Current value (bytes 6-9): Measured current value expressed in uA (1 = 100 nA). 32 bit float value. For example 0.5 value means 500 uA.

Absolute time (bytes 10-13): Absolute time at which ongoing samples are taken (a sum) [s]. 32 bit float value.

3.10. endMeasCa

ES sends this command to the PC right after the last giveMeasChunk was sent in order to close the measurement process.

Communicate:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Sync Byte	Command	Length 0	Length 1	Length 2	Length 3	CRC 0	CRC 1
‘?’ (0x3F)	0x0A	0x02	0x00	0x00	0x00	0xXX	0xXX

Answer:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Sync Byte	Command	Length 0	Length 1	Length 2	Length 3	CRC 0	CRC 1
‘?’ (0x3F)	0x0A	0x02	0x00	0x00	0x00	0xXX	0xXX

3.11. takeMeasDpv

PC sends all required parameters for the DPV measurement to the ES. After ES obtains the command it then checks the parameters. If they are all ok, he sends an ok ACK, if not, he sends an error code ACK.

Communicate:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Sync Byte	Command	Length 0	Length 1	Length 2	Length 3	QP 0	QP 1
‘?’ (0x3F)	0x0B	0x14	0x00	0x00	0x00	0xXX	0xXX

Byte 8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
QT 0	QT 1	PN 0	PN 1	PN 2	PN 3	PA 0	PA 1
0xXX	0xXX	0xXX	0x00	0x00	0x00	0xXX	0xXX

Byte 16	Byte 17	Byte 18	Byte 19	Byte 20	Byte 21	Byte 22	Byte 23
PP 0	PP 1	PW 0	PW 1	PS 0	PS 1	CRC 0	CRC 1
0xXX	0xXX	0xXX	0x00	0x00	0x00	0xXX	0xXX

QP (bytes 6-7): Set the quiet (starting) potential for the measure [mV]. Values from 0 to 1000 (unsigned 16 bit).

QT (bytes 8-9): Quiet (starting) time value- a time for which QP will be applied before the pulses start [s]. Values from 1 to 10000 (unsigned 16 bit).

PN (bytes 10-13): Total number of pulses applied in the measurement process. At halfway amplitude has to go down instead of up. Values from 1 to 1000000 (expressed as unsigned int 32 bit).

PA (bytes 14-15): Pulses amplitude (mV). Values from 0 to 1000 (16 bit unsigned short).

PP (bytes 16-17): Pulse period (ms). Values from 0 to 10000 (16 bit unsigned short).

PW (bytes 18-19): Pulse width (%). Pulse starts with low potential and ends in high potential. Values from 0 to 100 (16 bit unsigned short).

PS (bytes 20-21): Potential step [mV]. Each pulse the high and low potential values are incremented by this value. Values from 0 to 1000 (16 bit unsigned short).

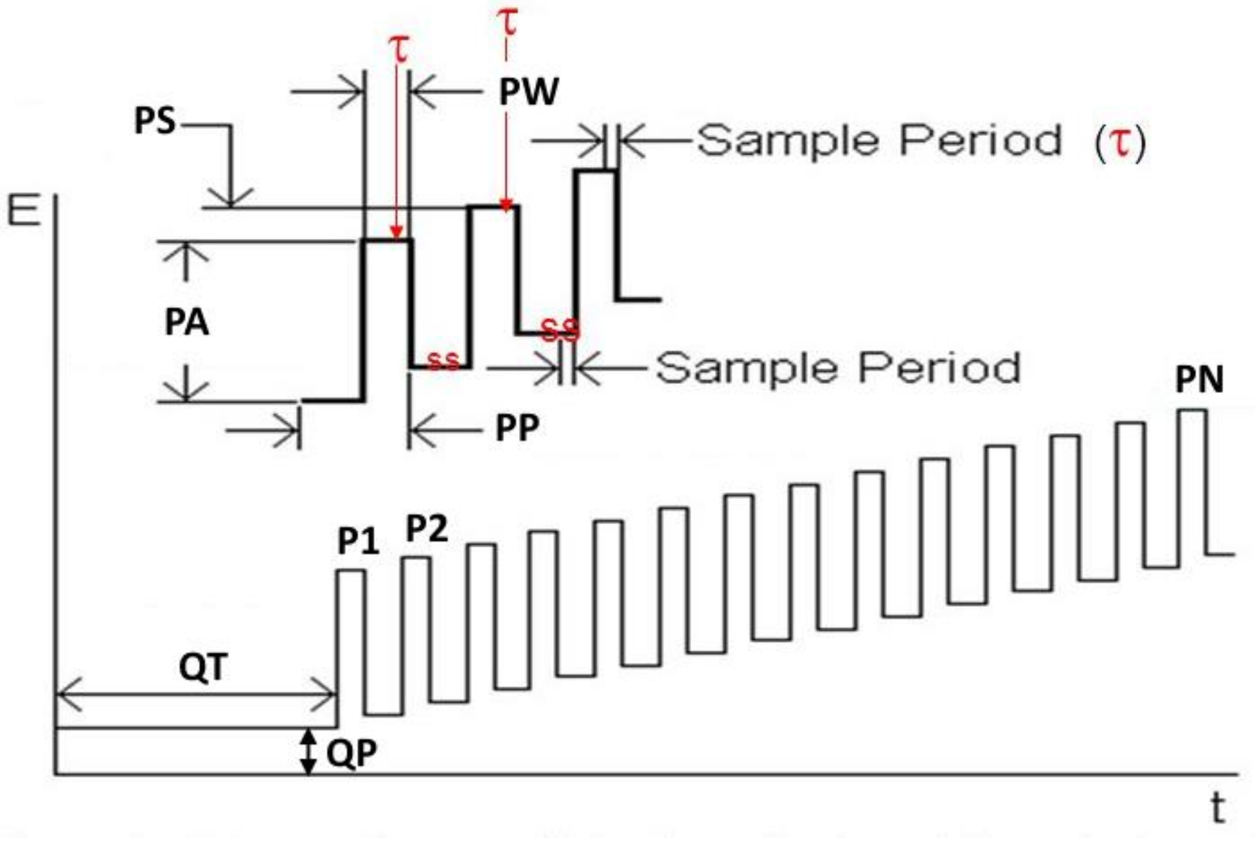


Figure 1. DPV values explained

Answer:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Sync Byte	Command	Length 0	Length 1	Length 2	Length 3	ACK	CRC 0
'?' (0x3F)	0x0B	0x03	0x00	0x00	0x00	0-1	0xXX

Byte 8
CRC 1
0xXX

ACK (Byte 6): 0 – parameters OK, 1 – parameters invalid, measurement won't be started.

3.12. giveMeasChunkDpv

ES sends measurement results to the PC (Current for a certain potential). This message required no answer.

Communicate:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Sync Byte	Command	Length 0	Length 1	Length 2	Length 3	Current value 0	Current value 1
'?' (0x3F)	0x0C	0x0A	0x00	0x00	0x00	0xXX	0xXX

Byte 8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Current value 2	Current value 3	Potential 0	Potential 1	Potential 2	Potential 3	CRC 0	CRC 1
0xXX	0xXX	0xXX	0xXX	0xXX	0xXX	0xXX	0xXX

Current value (bytes 6-9): Measured current value expressed in uA. 32 bit float value.

Potential (bytes 10-13): Corresponding potential value [mV]. 32 bit float value.

3.13. endMeasDpv

ES sends this command to the PC right after the last giveMeasChunk was sent in order to close the measurement process.

Communicate:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Sync Byte	Command	Length 0	Length 1	Length 2	Length 3	CRC 0	CRC 1
‘?’ (0x3F)	0x0D	0x02	0x00	0x00	0x00	0xXX	0xXX

Answer:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Sync Byte	Command	Length 0	Length 1	Length 2	Length 3	CRC 0	CRC 1
‘?’ (0x3F)	0x0D	0x02	0x00	0x00	0x00	0xXX	0xXX

3.14. takeMeasSwv

PC sends all required parameters for the Swv measurement to the ES. After ES obtains the command it then checks the parameters. If they are all ok, he sends an ok ACK, if not, he sends an error code ACK.

Communicate:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Sync Byte	Command	Length 0	Length 1	Length 2	Length 3	QP 0	QP 1
‘?’ (0x3F)	0x0E	0x12	0x00	0x00	0x00	0xXX	0xXX

Byte 8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
QT 0	QT 1	PN 0	PN 1	PN 2	PN 3	SWA 0	SWA 1
0xXX	0xXX	0xXX	0x00	0x00	0x00	0xXX	0xXX

Byte 16	Byte 17	Byte 18	Byte 19	Byte 20	Byte 21
PP 0	PP 1	PS 0	PS 1	CRC 0	CRC 1
0xXX	0xXX	0xXX	0x00	0x00	0x00

QP (bytes 6-7): Set the quiet (starting) potential for the measure [mV]. Values from 0 to 1000 (unsigned 16 bit).

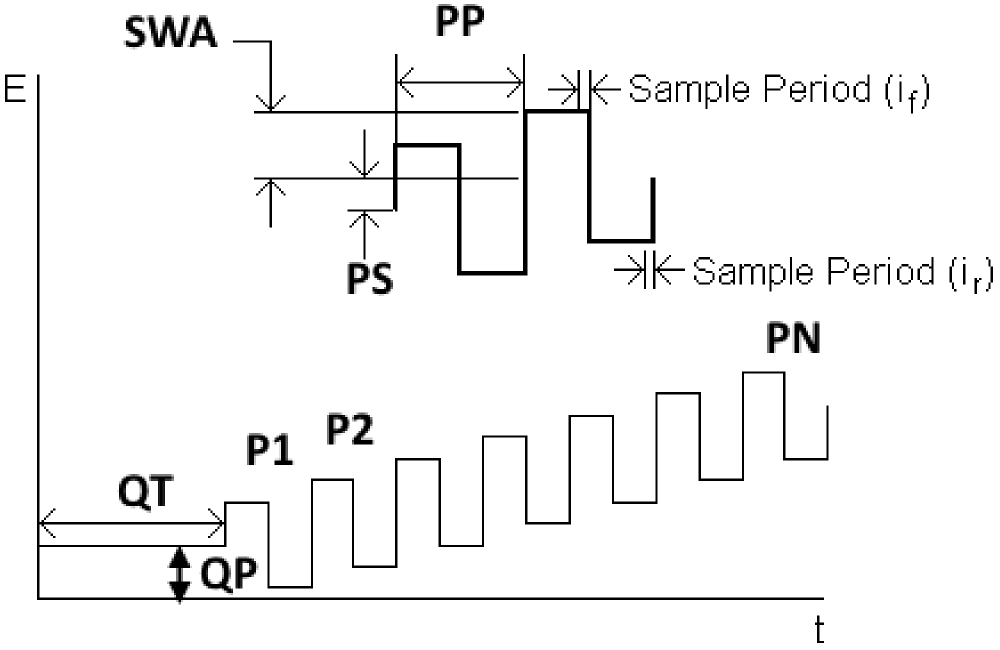
QT (bytes 8-9): Quiet (starting) time value- a time for which QP will be applied before the pulses start [s]. Values from 1 to 10000 (unsigned 16 bit).

PN (bytes 10-13): Total number of pulses applied in the measurement process. At halfway amplitude has to go down instead of up. Values from 1 to 1000000 (expressed as unsigned int 32 bit).

SWA (bytes 14-15): Square wave amplitude [mV]. Values from 0 to 1000 mV, unsigned 16 bit.

PP (bytes 16-17): Pulse period [ms]. Values from 0 to 10000 (16 bit unsigned short). Pulse width is always 50% with SWV.

PS (bytes 20-21): Potential step [mV]. Each pulse the high and low potential values are incremented by this value. Values from 0 to 1000 (16 bit unsigned short).



Answer:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Sync Byte	Command	Length 0	Length 1	Length 2	Length 3	ACK	CRC 0
‘?’ (0x3F)	0x0E	0x03	0x00	0x00	0x00	0-1	0xXX

Byte 8
CRC 1
0xXX

ACK (Byte 6): 0 – parameters OK, 1 – parameters invalid, measurement won’t be started.

3.15. giveMeasChunkSwv

ES sends measurement results to the PC (Current for a certain potential). This message required no answer.

Communicate:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Sync Byte	Command	Length 0	Length 1	Length 2	Length 3	Current value 0	Current value 1
‘?’ (0x3F)	0x0F	0x0A	0x00	0x00	0x00	0xXX	0xXX

Byte 8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Current value 2	Current value 3	Potential 0	Potential 1	Potential 2	Potential 3	CRC 0	CRC 1
0xXX	0xXX	0xXX	0xXX	0xXX	0xXX	0xXX	0xXX

Current value (bytes 6-9): Measured current value expressed in uA. 32 bit float value.

Potential (bytes 10-13): Corresponding potential value [mV]. 32 bit float value.

3.16. endMeasSwv

ES sends this command to the PC right after the last giveMeasChunk was sent in order to close the measurement process.

Communicate:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Sync Byte	Command	Length 0	Length 1	Length 2	Length 3	CRC 0	CRC 1
‘?’ (0x3F)	0x10	0x02	0x00	0x00	0x00	0xXX	0xXX

Answer:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Sync Byte	Command	Length 0	Length 1	Length 2	Length 3	CRC 0	CRC 1
‘?’ (0x3F)	0x10	0x02	0x00	0x00	0x00	0xXX	0xXX

4. Crc calculation

Crc is stored as an 2 byte unsigned integer value. CRC is calculated for every communicate and answer command and added at the end of that command. After the PC/ ES receives a message, it calculates the CRC for it and compares with the CRC of this sent message.

4.1. Algorithm

```
unsigned short GetCrc(unsigned char* buffer, unsigned short bytes)
{
        unsigned short i;
        unsigned short temp = 0;
        for(i = 0; i < bytes; i++)
        {
                temp += *buffer++;
        }
        temp =~ temp;
        return temp;
}
```

4.2. Example

getFirmwareID is sent from PC to ES, the whole message is:

```
0x3F 0x01 0x02 0x00 0x00 0x00 0xBD 0xFF
```

Embedded system receives this message and calculates the CRC of it (blue bytes):

```
0x3F + 0x01 + 0x02 + 0x00 + 0x00 + 0x00 = 0x0043
~0x0043 = 0xFFBD
```

Calculated CRC for this message matches the one that came along with it. That means the frame is corrent and an answer can be sent to the PC:

```
0x3F 0x01 0x06 0x00 0x00 0x00 0x00 0x00 0x00 0x01 0xB8 0xFF
```

PC receives the message and checks it by calculating CRC:

```
0x3F + 0x01 + 0x06 + 0x00 + 0x00 + 0x00 + 0x00 + 0x00 + 0x00 + 0x01 = 0x0047
~0x0047 = 0xFFB8
```

Calculated CRC matches the sent one. ES answered that its firmware number is 1.0.0.0 .