BT-Lab and EC-Lab

OLE COM

User Manual

EC-Lab v11.60 – January 2024

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1 Introduction

The OLE COM mode allows to pilot BT-Lab or EC-Lab software from LABVIEW for example, or any programming language that support the OLE COM.

By this way, one can develop applications that controls the instruments that are connected to BT-Lab and EC-Lab software.

In order to use OLE COM it is necessary to:

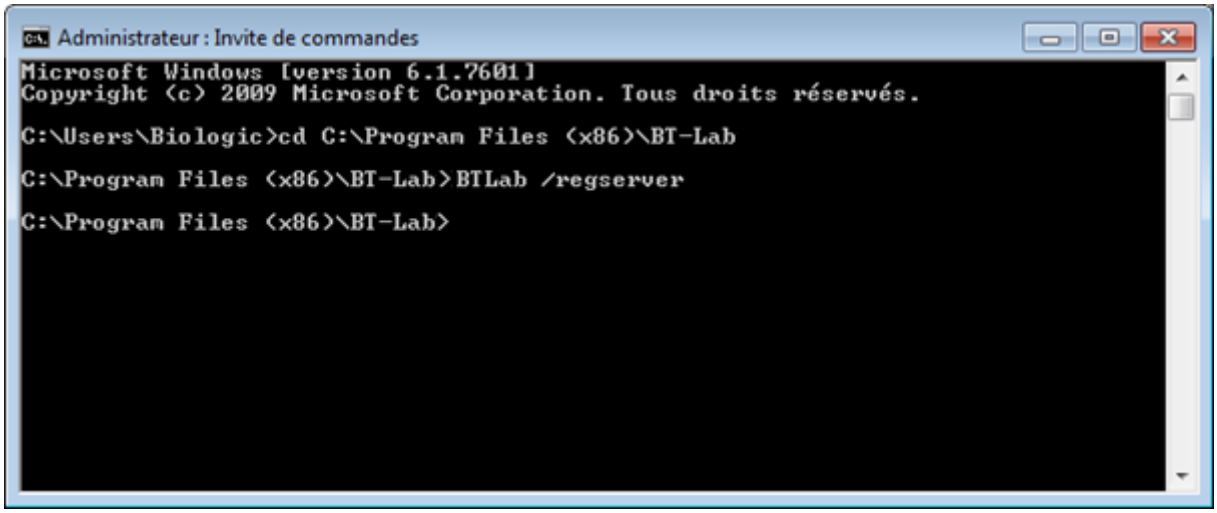
1. Activate the OLE COM mode for BT-Lab or EC-Lab. Once done BT-Lab or EC-Lab will act as an OLE COM server and will respond to any third party software that will connect to it.
2. Then the third party software has to connect to the BT-Lab or EC-Lab OLE COM server.
3. Use a list of commands to pilot BT-Lab or EC-Lab and perform experiments.

2 OLE COM Activation for BT-Lab and EC-Lab

By default, BT-Lab and EC-Lab are not registered to act as an OLE COM server. This has to be done to pilot these softwares by OLE COM commands.

Activation:

- Open an MS-DOS window. Warning: you must have administrator rights to register an OLE COM server. Thus, if you are not the PC administrator, select “run as administrator”.
- Go to the BT-Lab or EC-Lab installation folder (for example c:\Program Files (x86)\BT-Lab).
- For BT-Lab, type the command:
  - BTLab /regserver
- For EC-Lab, type:
  - ECLab /regserver



Note that there is no confirmation message. Nevertheless, if you have no administrator rights, there is an error message that informs you that the operation failed.

Deactivation:
By the same way, one can deactivate the OLE COM mode. Open an MS-DOS shell window into the application folder, type:

- For BT-Lab:
  - BTLab /unregserver
- For EC-Lab
  - ECLab /unregserver

2.1 BT-Lab or EC-Lab in OLE-COM mode

Once connected by a third party software in OLE COM mode the BT-Lab and EC-Lab software will display an OLECOM mode text within the status bar:

During OLECOM messages EC-Lab and BT-Lab will switch to an automatic mode and will not ask user for actions, like: “Run Experiment?” YES / NO. In that case YES response will be selected automatically. And then return to normal behavior when between OLECOM messages.

To fully disabled EC-Lab and BT-Lab messages you should use the function EnabledMessagesWindows (see § 3.2.25 page 14)

3 Functions List

3.1 List

Basic functions

Functions	TS	In BT/EC	Description
ConnectDevice	*TS*	BT & EC	Connect the selected device
DisonnectDevice	*TS*	BT & EC	Disconnect the selected device
LoadSettings	*TS*	BT & EC	Load input file settings to a channel
RunChannel	*TS*	BT & EC	Run the selected channel
StopChannel	*TS*	BT & EC	Stop the selected channel
MeasureStatus	*TS*	BT & EC	Return input device and channel current values
MeasureNumberOfPoints	*TS*	BT & EC	Return the number of points of input data file
MeasureDcValue	*TS*	BT & EC	Return one point from a DC data file
MeasureEisValue	*TS*	BT & EC	Return one point from an EIS data file

Other functions

Functions	TS	In BT/EC	Description
TestConnection	*TS*	BT & EC	Return if input device is connected
GetDeviceChannelList	*TS*	BT & EC	Return input device channel list
GetDataFileName	*TS*	BT & EC	Return input channel data file name
ConnectDeviceByIP	*TS*	BT & EC	Connect device by IP address
GetDeviceSN		BT & EC	Return input device serial number
GroupChannels		BT & EC	Group channels
SelectDevice		BT & EC	Select a Device
SelectChannel		BT & EC	Select a Channel
GetDeviceType		BT & EC	Not implemented
GetExperimentInfos		BT & EC	Get data from an experiment
MeasureValueByCode		BT & EC	Return one point from a data file by its code
MeasureValueByID		BT & EC	Return one point from a data file by its name
CopyMpsToMps		BT & EC	Not implemented
CopyMprToMps		BT & EC	Not implemented
CopyMptToMps		BT & EC	Not implemented
EnableMessagesWindows		BT & EC	Disabled EC-Lab/BT-Lab popup windows during OLECOM session
GetSoftwareVersion		BT & EC	Not implemented
GetChannelInfos		BT & EC	Get channel informations : amplifier, optionq
TestStand functions			Same functions but with _TS suffix for TestStand software compatibility.

The functions are present in both BT and EC -Lab. The check is done for BT & EC. The *TS* stands for TestStand functions.

3.2 Description

Below are specified the functions parameters.

3.2.1 ConnectDevice (DeviceNumber : integer) : Integer ;

- Input

  - Device number: device number in the list (0-based)
- Output
  - Result=1 if the device is connected, 0 else

3.2.2 DisconnectDevice (DeviceNumber : integer) : Integer ;

- Input
  - Device number: device number in the list (0-based)
- Output
  - Result=1 if the disconnection is done. 0 if the disconnection failed

3.2.3 TestConnection(DeviceNumber : integer) : integer ;

- Input
  - Device number: device number in the list (0-based)
- Output
  - Result=1 if the device is connected, 0 else

3.2.4 GetDeviceChannelList(out : ChannelArray : OleVariant(array[0..127] of WordBool) : Integer;

- Output
  - ChannelArray is an array of 128 channels with value 1 if channel is connected and 0 if channel is not connected. Up to 128 channels can be available for the BCS in BT-Lab, only the first 16 values are available for EC-Lab instruments.
  - Result=1 if the array is correct. 0 if the array cannot be filled.

3.2.5 LoadSettings (Device number: integer; Channel number: integer; File name absolute path: Widestring): Integer;

- Input
  - Device number: device number in the list (0-based)
  - Channel number: channel number (0-based)
  - File name absolute path: settings file (.mps or .mpr file)
- Output
  - Result=1 if the settings are correctly loaded. 0 if the loading failed

Note: This function will load the settings and will apply at the same time all the GUI modifications in BT/EC-Lab (modify + accept). Furthermore, this function will return false if the settings are not compatible with the hardware (Bandwidth, Irange, …).

3.2.6 RunChannel(Device number: integer; Channel number: integer; File name absolute path: Widestring): Integer;

- Input
  - Device number: device number in the list (0-based)
  - Channel number: channel number (0-based)
  - File name absolute path: Name of the output file
- Output
  - Launch a run. Result=1 if the run is correctly started. 0 if the run failed

3.2.7 StopChannel (Device number: integer; Channel number: integer): Integer;

- Input
  - Device number: device number in the list (0-based)
  - Channel number: channel number (0-based)
- Output
  - Stop a run. Result=1 if the stop is correctly done. 0 if the stop failed

3.2.8 GetDataFileName(DeviceNumber: integer ; ChannelNumber: integer; TechniqueNumber: integer, out Filename : OleVariant) : Integer;

- Input
  - Device number: device number in the list (0-based)
  - Channel number: channel number (0-based)
  - Technique number: technique number in the list (0-based)
- Output
  - Filename: the name of the .mpr corresponding
  - Result=1 if the filename is correct else 0.

3.2.9 MeasureStatus(Device number: integer; Channel number: integer; out StatusVariant :OleVariant (Current values, Safety limits status, connection status)) : Integer;

- Input
  - Device number: device number in the list (0-based)
  - Channel number: channel number (0-based)
- Output
  - StatusVariant is an array of 32 real values:

Index	Variable	Values
0	Status (see 1 below)	Stop = 0 Run = 1 Pause = 2 Sync = 3 Stop_rec1 = 4 Stop_rec2 = 5 Pause_rec = 6
1	Ox/Red	Oxidation = 0 Reduction =1
2	OCV	OCV = 0 Other = 1
3	EIS	EIS = 0 No EIS = 1
4	Technique number	Index of the technique into [0;19] (0-based)
5	Technique code	See annex 4.1
6	Sequence Number	
7	Current loop iteration number	See annex 4.3
8	Current sequence within loop number	See annex 4.3
9	Loop experiment iteration number	
10	Cycle number	For CV, EIS, VASP, CASP
11	Counter 1	For CV, ECN, SPFC, PR
12	Counter 2	Technique PR
13	Counter 3	Technique PR

14	Buffer Size	
15	Time	In s
16	Ewe	In V
17	Ece	In V
18	Eoc	In V
19	I	In A
20	Q-Q0	In A.h
21	Aux1	
22	Aux2	
23	Irange	In A
24	R Compensation	In Ohm
25	Frequency	In Hz
26	|Z|	In Ohm
27	Current point index	
28	Total point index	
29	T°	In °C
30	Safety limit	Ok = 0 Emax = 1 Emin = 2 I = 3 Q-Q0 = 4 Ewe min stack = 7 Ece min stack = 8 Ewe max stack = 9 Ece max stack = 10
31	Connection	Ok = 0 Disconnected = 1

- Result = 1 if the StatusVariant is correct, 0 else.

Warning: Fields are not reset if they are not relevant (see annex 4.2): for example, if you set an EIS technique with 38 points, at the end ‘Current point index’ and ‘Total point index’ will be ‘38’. Then if you run an OCV technique, ‘Current point index’ and ‘Total point index’ will always be ‘38’.
This function refresh the currents values.

(1) Below are described the status different values (variable 0):

Status	**Value**	**Description**
Stop	0	Channel is stopped
Run	1	Channel is running
Pause	2	Channel is paused

Sync	3	Channel is in synchronize mode i.e. it is waiting to the others ones (technique SYNC)
Stop_rec1	4	Special status between Run and Stop where the last points of the technique are being recorded
Stop_rec2	5	~ Stop_rec1
Pause_rec	6	Channel is paused and is recording some points (every 1h or 100 mV). This state is activated if a safety limit is reached.

3.2.10 MeasureNumberOfPoints(File name absolute path: Widestring) : integer;

- Input
  - File name absolute path (.mpr file)
- Output
  - The number of points contained into the input file.

3.2.11 MeasureDcValue(File name absolute path: Widestring; Data index: Integer; ArrayValue : OleVariant(Experiment elapsed time [sec], Voltage [V], Current [A])) : Integer;

- Input
  - Data index: index in the raw data file (0-based)
  - File name absolute path (.mpr file)
- Output
  - ArrayValue will be an array of data of the selected point in mpr file: < Experiment elapsed time in sec, Voltage in V, Current in A>
  - Result=1 if ArrayValue is filled correctly else 0.

3.2.12 MeasureEisValue(File name absolute path: Widestring; Data index: Integer; ArrayValue : OleVariant(Experiment elapsed time [sec], Frequency [Hz], real [Ohm], Imaginary [Ohm])) : Integer;

- Input
  - Data index: index in the raw data file (0-based)
  - File name absolute path (.mpr file)
- Output
  - ArrayValue will be an array of data of the selected point in mpr file : <Experiment elapsed time in sec, Frequency in Hz, Real in Ohm, Imaginary in Ohm>
  - Result=1 if ArrayValue is fill correctly else 0.

For DC techniques (OCV, CA, CP…), user should call MeasureDcValue() to retrieve values. Noticed that for the OCV techniques, the current value will be set to zero.
For EIS techniques (), user could use both functions MeasureDcValue() and MeasureEisValue(). MeasureEisValue() will return only the EIS values. If the point does not correspond to an EIS period, the returned frequency will be set to zero. Note that the Imaginary value is -Im(Z).
For invalid parameters, all returned values will be set to zero.
Note: These functions don't return cycles, charges or loop.

3.2.13 ConnectDeviceByIP (const IPaddress: WideString; out DeviceNumber: SYSINT): HResult;

- Input
  - IPaddress : IP address of the device to connect
- Output

  - DeviceNumber: Device number in the list (0-based)
- Result=1 if the device is connected, 0 else.
- Description:
  If the IP address of the device to connect is not into EC-Lab device list, it will be added to the list and EC-Lab will attempt to connect to the device. If the connection succeeds the device list number (0-based) is returned.

3.2.14 GetDeviceSN (DeviceNumber: integer; out DeviceSN: integer, out ModuleSNArray: OleVariant(array[0..15] of integer); out FunctionResult: integer): HResult;

Return device and modules serial numbers:

Variable	BCS	VMP
DeviceSN	BCS-COM SN	Instrument SN
ModuleSNArray[i] (I, 0-based)	BCS-8xx #i SN	Channel #i SN

If the module is not connected or the channel is not plugged then its serial number is set to 0.

3.2.15 SelectDevice (Device: SYSINT; out FunctionResult: SYSINT): HResult;

Select a Device

- Input
  - Device number: device number in the list (0-based)
- Output
  - FunctionResult =1 if the device is connected, 0 else
  - Result=FunctionResult

3.2.16 SelectChannel (Device, Channel: SYSINT; out FunctionResult: SYSINT): HResult;

- Input
  - Device number: device number in the list (0-based)
  - Channel number: channel number in the list (0-based)
- Output
  - FunctionResult =1 if the device and the channel are selected, 0 else
  - Result=FunctionResult

3.2.17 MeasureValueByCode (const FileName: WideString; VarCode: integer; DataIndex: integer;

out Data: Double; out FunctionResult: SYSINT): Integer;

- Input
  - File name absolute path (.mpr file)
  - Data index: index in the raw data file (0-based)
  - VarCode: the code of the requested variable (cf. § 4.4 Variables codes in annex)
- Output
  - Data: the value of the variable
  - FunctionResult=1 if success else 0
  - Result=FunctionResult

3.2.18 MeasureValueByID(const FileName, VarID: WideString; DataIndex: SYSINT; out Data: Double; out FunctionResult: SYSINT): HResult;

- Input
  - File name absolute path (.mpr file)

  - VarID: Name of the variable as it appears in the interface (cf. variables codes in annex)
  - DataIndex: index in the raw data file (0-based)
- Output
  - Data: the value of the variable
  - FunctionResult=1 if success else 0
  - Result=FunctionResult

3.2.19 GroupChannels (in NbChannels: integer; in ChannelsArray : OleVariant(array[0..2xNbChannels] of integer; out FunctionResult: integer): HResult;

Group channels from several devices.

Inputs

- NbChannels: the number of channels to group.
- ChannelsArray: the array of channels to group, 2 integers for each channel: the first is the device number, the second is the channel index

Output

- functionRes: 1 if the groupage is done, 0 else.

Warning: All channels must be identical: same device type, same amplifier, same head, same EIS option

3.2.20 GetDeviceType: Not implemented

3.2.21 GetExperimentInfos (DeviceNumber, ChannelNumber: SYSINT; out ExpStartTime, ExpEndTime, ExpPath, ExpDataFiles: OleVariant; out FunctionResult: SYSINT): HResult;

- Input
  - Device number: device number in the list (0-based)
  - Channel number: channel number in the list (0-based)
- Output
  - experiment start dateTime: string with AAAA-MM-JJ HH:MN:SS.ms format
  - experiment end dateTime calculated: string with the same format as above
  - experiment's files path: string containing the directory where to find the .mpr files
  - ExpDataFiles: data filenames in a varArray of strings, 0-based
  - FunctionResult =1 if the data are returned, 0 else
  - Result=
    - S_OK (0) if the data are returned
    - S_FALSE(1) if the experiment is in an inconsistent mode (mainly while modifying the experiment or before starting it)
    - E_FAIL($80004005) in all other cases

3.2.22 CopyMpsToMps(const InFileName: WideString; var OutFileName: WideString; out FunctionResult: SYSINT): HResult; Not implemented

3.2.23 CopyMprToMps(const InFileName: WideString; var OutFileName: WideString; out FunctionResult: SYSINT): HResult; stdcall; Not implemented

3.2.24 CopyMptToMps(const InFileName: WideString; var OutFileName: WideString; out FunctionResult: SYSINT): HResult; stdcall; Not implemented

3.2.25 EnableMessagesWindows(const EnabledWinMess: SYSINT; out FunctionResult: SYSINT): HResult;

- Input
  - EnabledWinMess:
    - If 1 then EC-Lab/BT-Lab can display popup messages (between OLECOM messages). OLECOM mode is displayed in blue in EC-lab/BT-Lab main window
    - If 0 then EC-Lab/BT-Lab will no longer display popup messages. OLECOM mode is displayed in orange in EC-lab/BT-Lab main window
- Output
  - FunctionResult =1 if the data are returned, 0 else
  - Result=
    - S_OK (0) if the data are returned
    - S_FALSE(1) if the experiment is in an inconsistent mode (mainly while modifying the experiment or before starting it)
    - E_FAIL($80004005) in all other cases

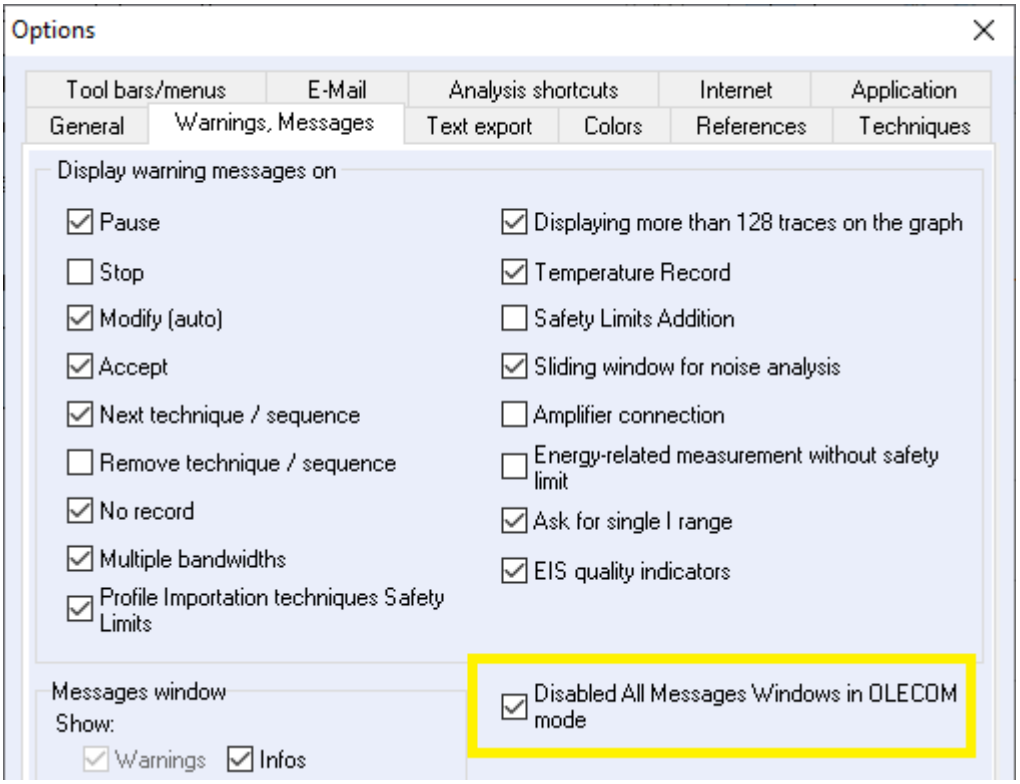
- EC-Lab / BT-Lab GUI

The OLECOM panel color changes to orange when the windows messages are disabled:

Messages enabled

Messages disabled

This option can be activated manually within the EC-Lab and BT-Lab into Config, Options, Warning, Messages, Disabled All Messages Windows in OLECOM mode check box :



This option is saved between EC-Lab / BT-Lab sessions. Nevertheless, it is better to call the EnableMessagesWindows() to force the mode independently from the GUI.

Note that when Windows messages are disabled, some actions are not possible within EC-Lab / BT-Lab, because messages windows are removed, ex: it is then not possible to run an experiment, because the saved file name is switched to the OLECOM message RunChannel (§ 3.2.6 page 7).

3.2.26 GetSoftwareVersion(out SoftwareVersion: WideString; out FunctionResult: SYSINT): HResult; Not implemented

3.2.27 GetChannelInfos(Device: SYSINT; Channel: SYSINT; out ChannelInfos: OleVariant; out FunctionResult: SYSINT): HResult;

- Input
  - Device number: device number in the list (0-based)
  - Channel number: channel number in the list (0-based)
- Output
  - ChannelInfos[] : array of 5 elements
    - ChannelInfos[0] = channel serial number
    - ChannelInfos[1] = channel amplifier ID (cf. § 4.5 Amplifier codes in annex)
    - ChannelInfos[2] = not implemented
    - ChannelInfos[3] = channel option (VMP-300 only)

Channel option code	Description
0	None
1	Standard
2	Low current
3	special

34	HV48
50	ULC coatings

        - ChannelInfos[4] = not implemented
    - FunctionResult =1 if the data are returned, 0 else
    - Result=
        - S_OK (0) if the data are returned
        - S_FALSE(1) if the experiment is in an inconsistent mode (mainly while modifying the experiment or before starting it)
        - E_FAIL($80004005) in all other cases

3.2.28 TestStand functions

Most of the functions are duplicated with _TS suffix for TestStand software compatibility.
The function with and without _TS are performing exactly the same way, except that:

- The _TS function duplicate the return value into its last FunctionResult argument.
- The _TS function return a HResult instead of an integer.

Exemple:

- ConnectDevice (DeviceNumber : integer) : Integer ;
- ConnectDevice_TS (DeviceNumber : integer; out FunctionResult: integer) : HResult ;

4 Annex

4.1 Correspondance Technique code <-> Technique name

1	Pdyn	Potentiodynamic Pitting
2	CPol	Cyclic Polarization
3	MUIC	Measure of U-I Correlation
4	GCPL	Galvanostatic Cycling with Potential Limitation
5	PCGA	Potentiodynamic Cycling with Galvanostatic Acceleration
6	CV	Cyclic Voltammetry
7	PotPit	Potentiostatic Pitting
8	PR	Polarization Resistance
9	PC	Potential Manual Control
10	ZVC	Zero Voltage Current
11	OCV	Open Circuit Voltage
12	GCPL2	Galvanostatic Cycling with Potential Limitation 2
13	NPV	Normal Pulse Voltammetry
14	SPFC	Stepwise Potential Fast Chronoamperometry
15	RNPV	Reverse Normal Pulse Voltammetry
16	APGC	Alternate Pulse Galvano Cycling
17	CPT	Critical Pitting Temperature 1
18	ECN	Electrochemical Noise (ASTM-G199)
19	GCPL3	Galvanostatic Cycling with Potential Limitation 3
20	DP	Depassivation Potential
21	MG	Modular Galvano
22	MP	Modular Potentio
23	CPP	Cyclic Potentiodynamic Polarization (ASTM-G61)
24	CA	Chronoamperometry / Chronocoulometry
25	CP	Chronopotentiometry
26	IC	Current Manual Control
27	Loop	Loop
28	WAIT	Wait
29	PEIS	Potentio Electrochemical Impedance Spectroscopy
30	GEIS	Galvano Electrochemical Impedance Spectroscopy
31	CPT2	Critical Pitting Temperature 2 (ASTM-G150)
32	LPR	Linear Polarization Resistance (ASTM-G59)
33	GCPL4	Galvanostatic Cycling with Potential Limitation 4
34	DPV	Differential Pulse Voltammetry
35	CLD	Constant Load Discharge
36	CPW	Constant Power
37	GCPL5	Galvanostatic Cycling with Potential Limitation 5
38	TO	Trigger Out

39	TI	Trigger In
40	SV	Staircase Voltammetry
41	SOCV	Special Open Circuit Voltage
42	SMP	Special Modular Potentio
43	SMG	Special Modular Galvano
44	SGCPL	Special Galvanostatic Cycling with Potential Limitation
45	SPEIS	Staircase Potentio Electrochemical Impedance Spectroscopy (Mott-Schottky)
46	SGEIS	Staircase Galvano Electrochemical Impedance Spectroscopy
47	SWV	Square Wave Voltammetry
48	EVT	Ecorr vs. Time
49	CM	Corrosimetry (Rp vs. Time)
50	ZIR	IR compensation (PEIS)
51	CVA	Cyclic Voltammetry Advanced
52	DNPV	Differential Normal Pulse Voltammetry
53	DPA	Differential Pulse Amperometry
54	CA	Chronoamperometry
55	OCV	Open Circuit Voltage
56	CP	Chronopotentiometry
57	CV	Cyclic Voltammetry
58	PDYN	Potentiodynamic
59	GDYN	Galvanodynamic
60	PEIS	Potentio Electrochemical Impedance Spectroscopy
61	GEIS	Galvano Electrochemical Impedance Spectroscopy
62	SPEIS	Staircase Potentio Electrochemical Impedance Spectroscopy
63	SGEIS	Staircase Galvano Electrochemical Impedance Spectroscopy
64	PEIS	Potentio Electrochemical Impedance Spectroscopy on Stack
65	GEIS	Galvano Electrochemical Impedance Spectroscopy on Stack
66	PDYN	Potentiodynamic on Stack
67	GDYN	Galvanodynamic on Stack
68	LOOP	Loop
69	CV ADV	Cyclic Voltammetry Advanced
70	DPV	Differential Pulse Voltammetry
71	SWV	Square Wave Voltammetry
72	NPV	Normal Pulse Voltammetry
73	RNPV	Reverse Normal Pulse Voltammetry
74	DNPV	Differential Normal Pulse Voltammetry
75	DPA	Differential Pulse Amperometry
76	EVT	Ecorr vs. Time
77	LP	Linear Polarization
78	GC	Generalized Corrosion
79	CPP	Cyclic Potentiodynamic Polarization
80	PDP	Potentiodynamic Pitting

81	PSP	Potentiostatic Pitting
82	ZRA	Zero Resistance Ammeter
83	MIR	Manual IR
84	PZIR	IR Determination with Potentiostatic Impedance
85	GZIR	IR Determination with Galvanostatic Impedance
86	MIR	Manual IR compensation
87	PEISW	Potentio Electrochemical Impedance Spectroscopy Wait
88	TI	Trigger In
89	TO	Trigger Out
90	TOS	Trigger Set
91	LASV	Large Amplitude Sinusoidal Voltammetry
92	ACV	AC Voltammetry
93	VASP	Variable Amplitude Sinusoidal micro Polarization
94	MUX	Multiplexer
95	CASP	Constant Amplitude Sinusoidal micro Polarization
96	CP L	Chronopotentiometry with limits
97	GDYN L	Galvanodynamic with limits
98	CA L	Chronoamperometry with limits
99	PDYN L	Potentiodynamic with limits
100	ABS	Absorbance
101	FLUO	Fluorescence
102	GPI	Galvano Profile Importation
103	PPI	Potentio Profile Importation
104	RPI	Resistance Profile Importation
105	PWPI	Power Profile Importation
106	LASV	Large Amplitude Sinusoidal Voltammetry
107	CI	Current Interrupt
108	LSV	Linear Sweep Voltammetry
109	MUX LP	Multiplexer Loop
110	IVC	I-V Characterization
111	TC	Temperature Control
112	RDEC	Rotating Disk Electrode Control
113	DABS	Dual Absorbance
114	ABS F	Absorbance/Fluorescence
115	Pause	Pause
116	EDC	External Device Control
117	CstV	Constant Voltage
118	CstC	Constant Current
119	GCPL6	Galvanostatic Cycling with Potential Limitation 6
120	CV_CA	Bipotentiostat CV & CA
121	CP_CA	Bipotentiostat CP & CA
122	CA_CA	Bipotentiostat CA & CA

123	MP	Modular Pulse
124	CV Lin	Cyclic Voltammetry Linear
125	CASG	Constant Amplitude Sinusoidal Galvanopolarization
126	LASV	Constant Amplitude Sinusoidal Polarization
127	MB	Modulo Bat
128	VASP	Variable Amplitude Sinusoidal Polarization
129	OCV F	Fast Open Circuit Voltage
130	CA F	Fast Chronoamperometry
131	CP F	Fast Chronopotentiometry
132	GCPL7	Galvanostatic Cycling with Potential Limitation 7
133	CV Lin	Cyclic Voltammetry Linear
134	STCC	Special Technique ChronoCoulometry
135	RCA	Ring Chronoamperometry
136	BCD	Battery Capacity Determination
137	CVL	Cyclic Voltammetry Linear
138	EXTAPP	External Application
139	EMAIL	Send E-Mail
140	CS	Current Scan
141	CED	Coulombic Efficiency Determination
142	EVANS	Evans diagram
143	TP	Tafel Plot
144	BECN	Biased Electrochemical Noise
145	Sync	Synchronization
146	RP	Repassivation potential (JIS0592)
147	GalC	Galvanic Coupling (ASTM-G71)

4.2 Relevant current values according to technique

For every techniques:

- OCV, EIS, Technique number, Technique code, sequence number, buffer, time, Ewe, Eoc, I, safety limit, connection
- Status, Ox/Red and IRange : except for CVL technique
- R compensation (if Ohmic drop determination technique before)
- Ece, Power, Aux1 and Aux2 if selected into Cell Characteristics.

Charge (Q-Q0) : all except CASP, PEISW, ZIR, SPEIS, SGEIS, PEIS, GEIS, VASP, SPFC, CVL

Ece: ECN, BECN, GalC, GCPL2, GCPL3 and other if record Ece is checked

Cycle: CV, SV, CVA, LASV, ACV, PEIS, GEIS, VASP, SPEIS, SGEIS, CASP

Counter 1: CV, SV, CVA, LASV, ACV, ZVC, ECN, BECN, GALC, SPFC, PR
Counter 2 and 3: PR

Frequency:

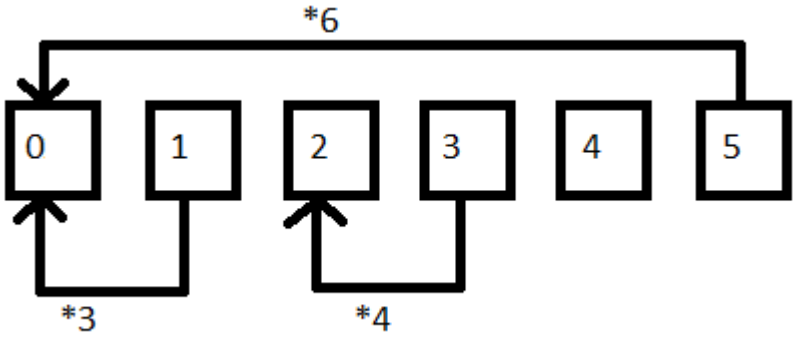
- PEIS, GEIS, VASP, SPEIS, SGEIS, ZIR, PEISW.
- MB and RP if the channel support EIS

|Z| : PEISW

Current point index and **total point index**: PEIS, GEIS, VASP, SPEIS, SGEIS

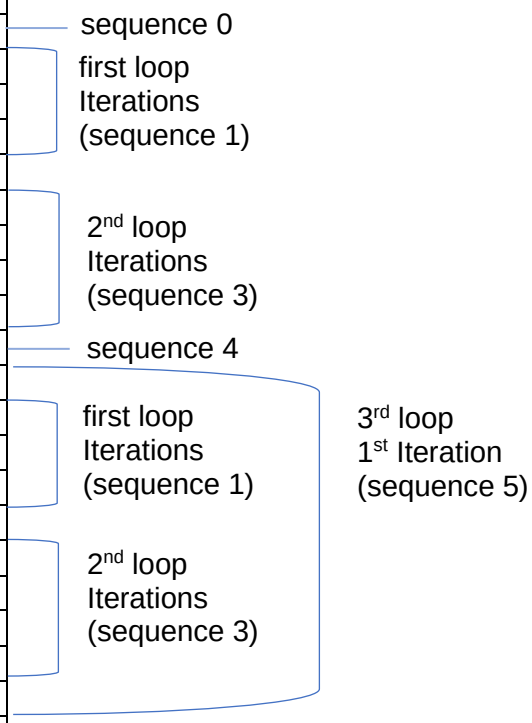
4.3 Get current sequence and iteration number

StatusVariant[7] and StatusVariant[8] return information about the smallest current sequence loop. StatusVariant[7] return the iteration number corresponding to the loop of the sequence StatusVariant[8]. For example, if we have a technique with 6 sequences (0 to 5) and sequence 1,3 and 5 are Loop type technique.



So, in this example, sequence 1 is a loop which go back to sequence 0 for 3 times, sequence 3 go back to sequence 2 for 4 times and sequence 5 go back to sequence 0 for 6 times.
Thus, the first time we are in the sequence 0, StatusVariant[7]=0 and StatusVariant[8]=0. When we enter in the 3 loops of sequence 1 we will have StatusVariant[7]=1,StatusVariant[8]=1 and StatusVariant[7]=2, StatusVariant[8]=1 and StatusVariant[7]=3,StatusVariant[8]=1.
The same thing will be done between sequence 2 and 3. First we'll have StatusVariant[7]=0, StatusVariant[8]=0 and when we enter in the 4 loops of sequence 3 we'll have StatusVariant[7]=1,StatusVariant[8]=3 and StatusVariant[7]=2, StatusVariant[8]=3 and StatusVariant[7]=3,StatusVariant[8]=3 and StatusVariant[7]=4,StatusVariant[8]=3.
Once we arrive in the sequence 5, we will go back in the sequence 0 for 6 times. So, when we go back in the sequence 0 we will have first StatusVariant[7]=1,StatusVariant[8]=5, and after, when we return in the loop of sequence 1, we will have again StatusVariant[7]=1, StatusVariant[8]=1 and StatusVariant[7]=2, StatusVariant[8]=1 … etc.
To summarize, these two fields contain the iteration number and the corresponding sequence of the smallest loop in progress.

Sequence Number (StatusVariant[6])	Current loop iteration number (StatusVariant[7])	Current sequence with loop number (StatusVariant[8])
0	0	0
0	1	1
0	2	1
0	3	1
2	0	0
2	1	3
2	2	3
2	3	3
2	4	3
4	0	0
0	1	5
0	1	1
0	2	1
0	3	1
2	1	5
2	1	3
2	2	3
2	3	3
2	4	3
4	1	5
0	2	5
…	…	…



4.4 Variables codes

Code	Description
1	mode
2	ox/red
3	error
4	time/s
5	control/V/mA
6	Ewe/V
7	dq/mA.h
8	I/mA
9	Ece/V
10	Aux/V
11	<I>/mA
12	log(|<I>/A|)
13	(Q-Qo)/mA.h
14	x
16	Analog IN 1/V
17	Analog IN 2/V
18	Analog IN 3/V
19	control/V
20	control/mA
21	control changes
22	log(|I/A|)
23	dQ/mA.h
24	cycle number
25	DQ/mA.h
26	Rapp/Ohm
27	Ewe-Ece/V
28	control/°C
29	T/°C
30	rotation rate/rpm
31	Ns changes
32	freq/Hz
33	|Ewe|/V
34	|I|/A
35	Phase(Z)/deg
36	|Z|/Ohm
37	Re(Z)/Ohm
38	-Im(Z)/Ohm
39	I Range
40	Q charge/mA.h
41	Q discharge/mA.h
42	Q charge (mA.h/g)
43	Q discharge (mA.h/g)
44	Q anodic/C
45	Q cathodic/C
46	Q anodic (C/cm²)
47	Q cathodic (C/cm²)
48	Tech Num

49	End buf
50	E0/V
51	Ian min/mA
52	Ian max/mA
53	Ica min/mA
54	Ica max/mA
55	Ean end/V
56	Eca end/V
57	Ece min/V
58	Ece max/V
59	Analog IN 1/V min
60	Analog IN 1/V max
61	Analog IN 2/V min
62	Analog IN 2/V max
63	Analog IN 3/V min
64	Analog IN 3/V max
65	counter inc.
66	I forward/mA
67	I reverse/mA
68	I delta/µA
69	R/Ohm
70	P/W
71	control/°C
72	T/°C
73	rotation rate/rpm
74	|Energy|/W.h
75	Analog OUT/V
76	<I>/mA
77	<Ewe>/V
78	Cs-2/µF-2
79	E step/V
80	Rp/Ohm
81	Ecorr/V
82	Icorr/mA
83	I/A/cm2
84	Q/C/cm2
85	Aux
86	Unk1
87	Unk2
88	Unk3
89	Unk4
90	Unk5
91	Unk6
92	Unk7
93	Unk8
94	Unk9
95	Unk10
96	|Ece|/V
97	|Ice|/A
98	Phase(Zce)/deg
99	|Zce|/Ohm
100	Re(Zce)/Ohm
101	-Im(Zce)/Ohm
102	Cce-2/µF-2
103	Estack/V
104	Istack/A
105	|E21|/V
106	Phase(Z21)/deg

107	|E32|/V
108	Phase(Z32)/deg
109	|Z21|/Ohm
110	Re(Z21)/Ohm
111	-Im(Z21)/Ohm
112	C21-2/µF-2
113	|Z32|/Ohm
114	Re(Z32)/Ohm
115	-Im(Z32)/Ohm
116	C32-2/µF-2
117	E21/V
118	E32/V
119	Re(Y)/Ohm-1
120	Im(Y)/Ohm-1
121	|Y|/Ohm-1
122	Phase(Y)/deg
123	Energy charge/W.h
124	Energy discharge/W.h
125	Capacitance charge/µF
126	Capacitance discharge/µF
127	Delta(Phase(Z))/%
128	Delta(|Z|)/%
129	Delta(Re(Z))/%
130	Delta(-Im(Z))/%
131	Ns
132	dI/dt/mA/s
133	Delta(mass)/g
134	Custom01
135	Custom02
136	Custom03
137	Custom04
138	Custom05
139	Custom06
140	Custom07
141	Custom08
142	Custom09
143	Custom10
144	Custom11
145	Custom12
146	Custom13
147	Custom14
148	Custom15
149	Custom16
150	Custom17
151	Custom18
152	Custom19
153	Custom20
154	Delta(Phase(Y))/%
155	Delta(|Y|)/%
156	Delta(Re(Y))/%
157	Delta(-Im(Y))/%
158	t low
159	t high
160	dt/dE/s/V
161	Delta(Phase(Z))/deg
162	Delta(Phase(Y))/deg
163	|Estack|/V
164	|Istack|/A

167	Phase(I)/rad
168	Rcmp/Ohm
169	Cs/µF
170	sin ampl/V
171	Conductivity/S.cm-1
172	Cp/µF
173	Cp-2/µF-2
174	<Ewe>/V
175	Efficiency/%
176	Cycling rate charge
177	Cycling rate discharge
178	Wavelength/nm
179	Fluorescence/V
180	Fluorescence/%
181	Transmittance/%
182	CD/mdeg
183	ORD/mdeg
184	Aniso Vv/V
185	Aniso Vh/V
186	LD Vv/V
187	LD Vh/V
188	LD/deltaA
189	Anisotropy/Aniso
190	T peltier/°C
191	T cuvette/°C
192	Absorbance/AU
193	HV/V
194	Absorbance2/AU
195	Absorbance/V
196	If/mA
197	Ic/mA
198	CA/mol.L-1
199	CB/mol.L-1
200	CC/mol.L-1
201	CD/mol.L-1
202	CE/mol.L-1
203	CF/mol.L-1
204	CG/mol.L-1
205	CH/mol.L-1
206	CI/mol.L-1
207	CJ/mol.L-1
208	shot number
209	pad number
210	electrode number
211	E1/V
212	E2/V
213	E3/V
214	E4/V
215	E5/V
216	E6/V
217	E7/V
218	E8/V
219	E9/V
220	E10/V
221	E11/V
222	E12/V
223	E13/V
224	E14/V

225	E15/V
226	E16/V
227	E17/V
228	E18/V
229	E19/V
230	E20/V
231	E21/V
232	E22/V
233	E23/V
234	E24/V
235	E25/V
236	E26/V
237	E27/V
238	E28/V
239	E29/V
240	E30/V
241	|E1|/V
242	|E2|/V
243	|E3|/V
244	|E4|/V
245	|E5|/V
246	|E6|/V
247	|E7|/V
248	|E8|/V
249	|E9|/V
250	|E10|/V
251	|E11|/V
252	|E12|/V
253	|E13|/V
254	|E14|/V
255	|E15|/V
256	|E16|/V
257	|E17|/V
258	|E18|/V
259	|E19|/V
260	|E20|/V
261	|E21|/V
262	|E22|/V
263	|E23|/V
264	|E24|/V
265	|E25|/V
266	|E26|/V
267	|E27|/V
268	|E28|/V
269	|E29|/V
270	|E30|/V
271	Phase(Z1)/deg
272	Phase(Z2)/deg
273	Phase(Z3)/deg
274	Phase(Z4)/deg
275	Phase(Z5)/deg
276	Phase(Z6)/deg
277	Phase(Z7)/deg
278	Phase(Z8)/deg
279	Phase(Z9)/deg
280	Phase(Z10)/deg
281	Phase(Z11)/deg
282	Phase(Z12)/deg

283	Phase(Z13)/deg
284	Phase(Z14)/deg
285	Phase(Z15)/deg
286	Phase(Z16)/deg
287	Phase(Z17)/deg
288	Phase(Z18)/deg
289	Phase(Z19)/deg
290	Phase(Z20)/deg
291	Phase(Z21)/deg
292	Phase(Z22)/deg
293	Phase(Z23)/deg
294	Phase(Z24)/deg
295	Phase(Z25)/deg
296	Phase(Z26)/deg
297	Phase(Z27)/deg
298	Phase(Z28)/deg
299	Phase(Z29)/deg
300	Phase(Z30)/deg
301	|Z1|/Ohm
302	|Z2|/Ohm
303	|Z3|/Ohm
304	|Z4|/Ohm
305	|Z5|/Ohm
306	|Z6|/Ohm
307	|Z7|/Ohm
308	|Z8|/Ohm
309	|Z9|/Ohm
310	|Z10|/Ohm
311	|Z11|/Ohm
312	|Z12|/Ohm
313	|Z13|/Ohm
314	|Z14|/Ohm
315	|Z15|/Ohm
316	|Z16|/Ohm
317	|Z17|/Ohm
318	|Z18|/Ohm
319	|Z19|/Ohm
320	|Z20|/Ohm
321	|Z21|/Ohm
322	|Z22|/Ohm
323	|Z23|/Ohm
324	|Z24|/Ohm
325	|Z25|/Ohm
326	|Z26|/Ohm
327	|Z27|/Ohm
328	|Z28|/Ohm
329	|Z29|/Ohm
330	|Z30|/Ohm
331	Re(Z1)/Ohm
332	Re(Z2)/Ohm
333	Re(Z3)/Ohm
334	Re(Z4)/Ohm
335	Re(Z5)/Ohm
336	Re(Z6)/Ohm
337	Re(Z7)/Ohm
338	Re(Z8)/Ohm
339	Re(Z9)/Ohm
340	Re(Z10)/Ohm

341	Re(Z11)/Ohm
342	Re(Z12)/Ohm
343	Re(Z13)/Ohm
344	Re(Z14)/Ohm
345	Re(Z15)/Ohm
346	Re(Z16)/Ohm
347	Re(Z17)/Ohm
348	Re(Z18)/Ohm
349	Re(Z19)/Ohm
350	Re(Z20)/Ohm
351	Re(Z21)/Ohm
352	Re(Z22)/Ohm
353	Re(Z23)/Ohm
354	Re(Z24)/Ohm
355	Re(Z25)/Ohm
356	Re(Z26)/Ohm
357	Re(Z27)/Ohm
358	Re(Z28)/Ohm
359	Re(Z29)/Ohm
360	Re(Z30)/Ohm
361	-Im(Z1)/Ohm
362	-Im(Z2)/Ohm
363	-Im(Z3)/Ohm
364	-Im(Z4)/Ohm
365	-Im(Z5)/Ohm
366	-Im(Z6)/Ohm
367	-Im(Z7)/Ohm
368	-Im(Z8)/Ohm
369	-Im(Z9)/Ohm
370	-Im(Z10)/Ohm
371	-Im(Z11)/Ohm
372	-Im(Z12)/Ohm
373	-Im(Z13)/Ohm
374	-Im(Z14)/Ohm
375	-Im(Z15)/Ohm
376	-Im(Z16)/Ohm
377	-Im(Z17)/Ohm
378	-Im(Z18)/Ohm
379	-Im(Z19)/Ohm
380	-Im(Z20)/Ohm
381	-Im(Z21)/Ohm
382	-Im(Z22)/Ohm
383	-Im(Z23)/Ohm
384	-Im(Z24)/Ohm
385	-Im(Z25)/Ohm
386	-Im(Z26)/Ohm
387	-Im(Z27)/Ohm
388	-Im(Z28)/Ohm
389	-Im(Z29)/Ohm
390	-Im(Z30)/Ohm
391	<E1>/V
392	<E2>/V
393	<E3>/V
394	<E4>/V
395	<E5>/V
396	<E6>/V
397	<E7>/V
398	<E8>/V

399	<E9>/V
400	<E10>/V
401	<E11>/V
402	<E12>/V
403	<E13>/V
404	<E14>/V
405	<E15>/V
406	<E16>/V
407	<E17>/V
408	<E18>/V
409	<E19>/V
410	<E20>/V
411	<E21>/V
412	<E22>/V
413	<E23>/V
414	<E24>/V
415	<E25>/V
416	<E26>/V
417	<E27>/V
418	<E28>/V
419	<E29>/V
420	<E30>/V
421	Phase2/deg
422	Phase(Zstack)/deg
423	|Zstack|/Ohm
424	Re(Zstack)/Ohm
425	-Im(Zstack)/Ohm
426	<Estack>/V
427	<Istack>/mA
428	Potential/V
429	Potential/V
430	Phase(Zwe-ce)/deg
431	|Zwe-ce|/Ohm
432	Re(Zwe-ce)/Ohm
433	-Im(Zwe-ce)/Ohm
434	(Q-Qo)/C
435	dQ/C
436	Ece dc/V
437	cycle time/s
438	step time/s
439	charge time/s
440	discharge time/s
441	<Ece>/V
442	d(Q-Qo)/dE/mA.h/V
443	Capacity/mA.h
444	control disk/V
445	control disk/mA
446	Edisk/V
447	Ecedisk=Ecering/V
448	Idisk/mA
449	dQdisk/C
450	(Q-Qo)disk/C
451	cycle number
452	control ring/V
453	Ering/V
454	Iring/mA
455	(Q-Qo)ring/C
456	Pdisk/W

457	Pring/W
458	Edisk-Ece/V
459	Ering-Ece/V
460	<time>/s
461	<EweX>/V
462	Temperature/°C
463	Ramp upwards
464	Time/µs
465	I Range disk
466	I Range ring
467	Q charge/discharge/mA.h
468	half cycle
469	z cycle
470	It/mA
471	<Ece>/V
472	Vcorr/mm/yr
473	THD Ewe/%
474	THD I/%
475	THD Ece/%
476	NSD Ewe/%
477	NSD I/%
478	NSD Ece/%
479	NSR Ewe/%
480	NSR I/%
481	NSR Ece/%
482	ShuntIsChanging
483	ModeIsChanging
484	NbIterInstr
485	Instr
486	|Ewe h2|/V
487	|Ewe h3|/V
488	|Ewe h4|/V
489	|Ewe h5|/V
490	|Ewe h6|/V
491	|Ewe h7|/V
492	|I h2|/A
493	|I h3|/A
494	|I h4|/A
495	|I h5|/A
496	|I h6|/A
497	|I h7|/A
498	|Ece h2|/V
499	|Ece h3|/V
500	|Ece h4|/V
501	|Ece h5|/V
502	|Ece h6|/V
503	|Ece h7|/V
504	Rac/Ohm
505	Rdc/Ohm
506	TCU control/°C
507	TCU meas. /°C
508	Regulation
509	Acir/Dcir Control
510	LTime/s
511	Re(C)/nF
512	Im(C)/nF
513	|C|/nF
514	Phase(C)/deg

515	Re(M)
516	Im(M)
517	|M|
518	Phase(M)/deg
519	Re(Permittivity)
520	Im(Permittivity)
521	|Permittivity|
522	Phase(Permittivity)/deg
523	Re(Conductivity)/mS/cm
524	Im(Conductivity)/mS/cm
525	|Conductivity|/mS/cm
526	Phase(Conductivity)/deg
527	Re(Resistivity)/Ohm.cm
528	Im(Resistivity)/Ohm.cm
529	|Resistivity|/Ohm.cm

530	Phase(Resistivity)/deg
531	Tan(Delta)
532	Loss Angle(Delta)/deg
533	TCU base /°C
534	TCU cell /°C
535	TCU sample/°C
536	Ewe initial/V
537	Ewe final/V
538	I initial/mA
539	I final/mA
540	P min/W
541	P max/W
542	T min/°C
543	T max/°C

4.5 Amplifier codes

Code	Description
0	No amplifier
1	2 A amplifier
2	1 A amplifier
3	5 A amplifier
4	10 A amplifier
5	20 A amplifier
6	100 mA 40 V amplifier
7	low current option
8	80 A amplifier
9	4 A amplifier
10	unused
11	4 A amplifier
12	low current option
13	unused
14	MUIC special cable
15	No amplifier
16	8 A amplifier
17	500 W load box
18	100 A amplifier
19	2 kW load box
20	1A 48V amplifier
21	4 A 14 V amplifier
22	5 A amplifier
23	10 A amplifier
24	20 A amplifier
25	40 A amplifier
26	Coin cell holder
27	10 A 5V amplifier
28	2A 30V amplifier
29	8 A 14 V amplifier
30	12 A 14 V amplifier
31	16 A 14 V amplifier
32	20 A 14 V amplifier
33	24 A 14 V amplifier
34	28 A 14 V amplifier
35	32 A 14 V amplifier

36	36 A 14 V amplifier
37	40 A 14 V amplifier
38	44 A 14 V amplifier
39	48 A 14 V amplifier
40	52 A 14 V amplifier
41	56 A 14 V amplifier
42	60 A 14 V amplifier
43	64 A 14 V amplifier
44	20 A 5V amplifier
45	30 A 5V amplifier
46	40 A 5V amplifier
47	50 A 5V amplifier
48	60 A 5V amplifier
49	70 A 5V amplifier
50	80 A 5V amplifier
51	90 A 5V amplifier
52	100 A 5V amplifier
53	110 A 5V amplifier
54	120 A 5V amplifier
55	130 A 5V amplifier
56	140 A 5V amplifier
57	150 A 5V amplifier
58	160 A 5V amplifier
59	4A 30V amplifier
60	6A 30V amplifier
61	8A 30V amplifier
62	10A 30V amplifier
63	12A 30V amplifier
64	14A 30V amplifier
65	16A 30V amplifier
66	18A 30V amplifier
67	20A 30V amplifier
68	22A 30V amplifier
69	24A 30V amplifier
70	26A 30V amplifier
71	28A 30V amplifier
72	30A 30V amplifier

73	32A 30V amplifier
74	30 A amplifier
75	60 A amplifier
76	120 A amplifier
77	HCV-3048 amplifier
78	HCV-6048 amplifier
79	HCV-9048 amplifier
80	HCV-12048 amplifier
81	HCV-15048 amplifier
82	HCV-18048 amplifier
83	HCV-21048 amplifier
84	HCV-24048 amplifier
85	HCV-27048 amplifier
86	HCV-30048 amplifier
87	HCV-33048 amplifier
88	HCV-36048 amplifier
89	HCV-39048 amplifier
90	HCV-42048 amplifier
91	HCV-45048 amplifier
92	HCV-48048 amplifier
93	FlexP 0160
94	FlexP0160/2
95	FlexP0160/3
96	FlexP0160/4
97	FlexP 0012
98	FlexP0012/2
99	FlexP0012/3
100	FlexP0012/4
101	FlexP 0060
102	FlexP0060/2
103	FlexP0060/3
104	FlexP0060/4
105	1A 48V b amplifier
106	2A 48V amplifier
107	3A 48V amplifier
108	4A 48V amplifier

109	5A 48V amplifier
110	6A 48V amplifier
111	7A 48V amplifier
112	8A 48V amplifier
113	9A 48V amplifier
114	10A 48V amplifier
115	11A 48V amplifier
116	12A 48V amplifier
117	13A 48V amplifier
118	14A 48V amplifier
119	15A 48V amplifier
120	16A 48V amplifier
121	FlexP 0160_24V
122	FlexP0160_24V/2
123	FlexP0160_24V/3
124	FlexP0160_24V/4
125	FlexP 0060_24V
126	FlexP0060_24V/2
127	FlexP0060_24V/3
128	FlexP0060_24V/4
129	1A 48V p amplifier
130	2A 48V amplifier
131	3A 48V amplifier
132	4A 48V amplifier
133	5A 48V amplifier
134	6A 48V amplifier
135	7A 48V amplifier
136	8A 48V amplifier
137	9A 48V amplifier
138	10A 48V amplifier
139	11A 48V amplifier
140	12A 48V amplifier
141	13A 48V amplifier
142	14A 48V amplifier
143	15A 48V amplifier
144	16A 48V amplifier

5 Technical specifications

5.1 BT-Lab and EC-Lab minimum version requirement

Versions that include the OLE COM mode:

- EC-Lab v11.11, 03/14/2017 or higher
- BT-Lab v1.57, 11/16/2017 or higher

5.2 PC minimal requirement

Microsoft Windows 7 SP1
Compatible with Windows 8-10