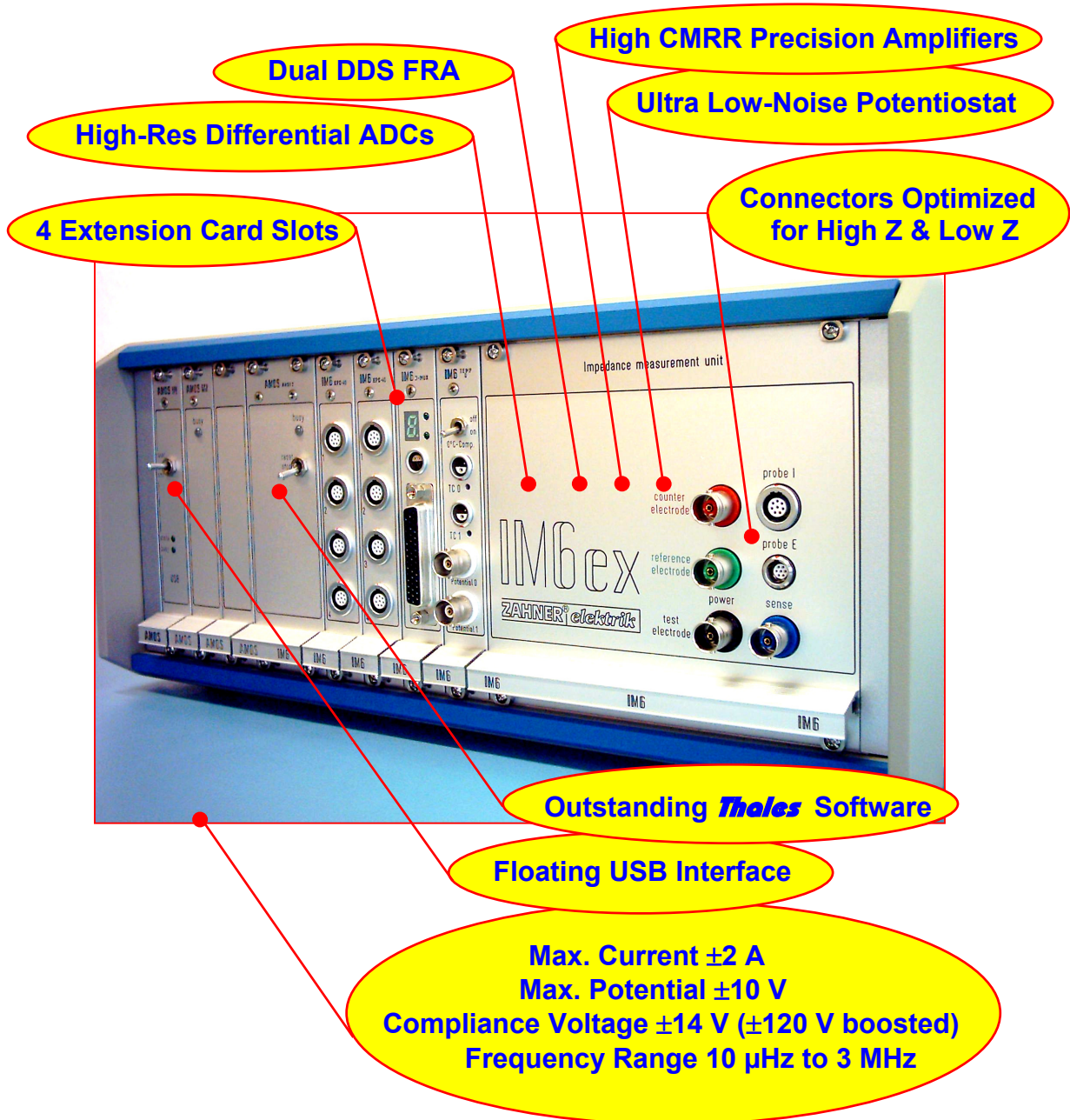


Electrochemical Workstation **IM6ex**

Xtended Version - Xtended Features



Zahner

The Electrochemical Workstation **IM6ex** is the latest member of the famous **IM** family. It was developed using our 20 years of experience in building high-precision, versatile and reliable electrochemical workstations of the high-end class. Based on the **IM6e**, it provides extended features such as a wider frequency range, additional extension card slots or a USB interface. Special, partially patented measurement techniques guarantee an ultra high accuracy and a minimal interference with the test object.

The **IM6ex** comes bundled with the outstanding Thales software package which offers all standard methods and many more. This is why the **IM6ex** can easily be adapted to very different measurement requirements. Furthermore, with the manifold options available, the **IM6ex** is able to grow with the tasks. Thus, it is best suited for investigations on fuel cells and batteries as well as on membranes and sensors or on coatings and laminates – to name only some.

Last but not least, Zahner is known to provide the most competent service all around the world. Our service team helps you to chose an appropriate system configuration, to getting started and to optimize your set-up.

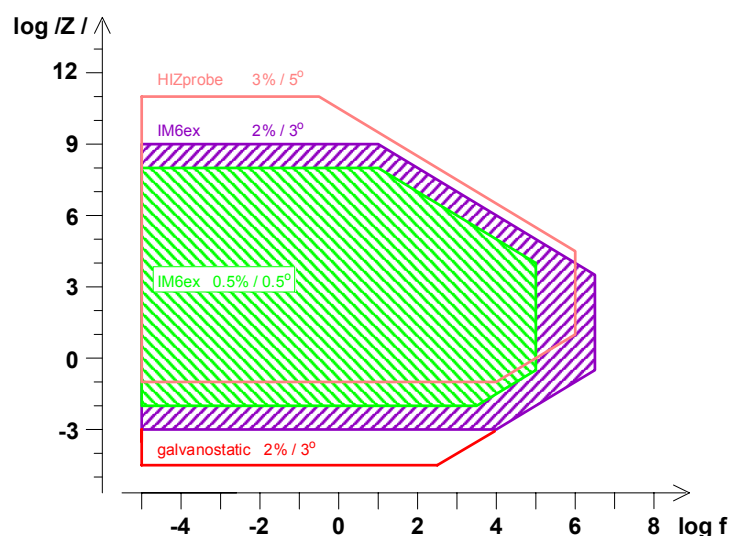
Zahner

The hardware of the **IM6ex** is based on the popular IM6e model. It provides

- ultra low-noise potentiostat
- wide frequency range FRA
- high-precision U/I-amplifiers
- high resolution parallel ADCs

All these components are designed to work together in a perfect way. This results in a homogeneous instrument with extraordinary technical data.

The accuracy map of the **IM6ex** clearly shows the high quality of the hardware.



The **IM6ex** is a highly versatile instrument which can be extended with additional hardware and software. This makes it easy to adapt it to a lot of very different applications from the high-impedance end (corrosion, laminates, coatings, etc.) to low-impedance objects (batteries, fuel cells, etc.). Also, if in the course of an investigation it turns out that additional methods are needed, it is no problem to fit the **IM6ex** to that. For this purpose the **IM6ex** provides 4 slots for plug & play extension cards. Thus, you may have up to e.g. 16 external potentiostats connected to the **IM6ex**. No matter if you decide to record additional channels (temperature, pH, etc.) or if you need higher currents or you have to investigate electrochemical noise or ... or ... - simply plug in the appropriate hardware option, connect the test object and start working. The **Thales** software supports all options automatically and provides the methods needed.

Option	Function	ext	int	EPC40 needed
TEMP/U	2 inputs for thermocouples + 2 voltage inputs		x	
DA4	4 analogue outputs		x	
RMux	Relais multiplexer for internal potentiostat		x	
PwrMux	Power multiplexer for PP series potentiostat	x	x	
TR8M	Transient recorder up to 20 MHz		x	
HiZ probe	High impedance probe set	x		
LoZ	Cable set for low impedances	x		
EPC40	Control module for up to 4 external potentiostats		x	
EPot	External standard potentiostat	x		x
PP series	External power potentiostats	x		x
EL series	External electronic one quadrant potentiostats	x		x
NProbe	Probe set for measuring electrochemical noise	x		x
COLT	Set-up for coating and laminate testing			
CIMPS	Set-up for photo-intensity controlled IMPS	x		x
EICChem Cells	KMZ and AMZ type cells for various applications			

The highest priorities for the development and production of the **IM6ex** instruments are accuracy and reliability. For that reason we do not waste paper with senseless specifications like a "virtual" resolution calculated from the range and the resolution of the AD converter. The resolution and accuracy we specify are real ones and base on the high-end hardware we use.

The Thales package equipped with the **IM6ex** is one of the most sophisticated software for electrochemical applications. On the one hand it provides a huge variety of methods, on the other hand it is easy to use even for not trained personnel. Help pages are popping up on a mouse click showing hints for most of the functions.

With **SIM**, the user is able to design equivalent networks on the screen and fit it to the measured data. We are proud to say that especially this software is the most sophisticated one in the market. Besides a big library of all electrochemical standard elements you can easily add user-elements. Other highlight are the automatic finding of starting values for the used elements and the intelligent and fast fitting algorithm.

The **SCRIPT** feature allows to set up individual procedures easily, so that even complex measurement, analysis and documentation tasks are carried out automatically. There are some ready-to-use **SCRIPTs** available from Zahner, such as **COLT** or **CIMPS**.

Thales supports a great variety of methods:

Supported Method	Module	Option
Electrochemical Impedance Spectroscopy	EIS	-
EIS Series Measurements vs. Parameters	EIS	-
Impedance Network Analysis, Simulation & Fitting	SIM	-
Impedance/Parameter, Capacity/Voltage Curves	C/E	-
AC Voltammetry	C/E	-
Cyclic Voltammetry	CV	-
Steady State Current/Voltage Curves	I/E	-
Multi-Cell Current/Voltage Curves	MI/E	EPC40
Corrosion / Polarisation Measurement	POL	-
Chronoamperometry	PVI	-
Linear Sweep Voltammetry	PVI	-
Electrochemical Noise	NOISE	Noise
CorrEINoise	NOISE	Noise
Tast Polarography	PGY	-
Differential Pulse Polarography	PGY	-
Differential Pulse Voltammetry	PGY	-
Stripping Voltammetry	PGY	-
Standard Addition Measurement & Analysis	PGY	-
Universal Measurement Data Acquisition & Control	ACQ	NET*
Universal Frequency Analysis	FRA	-
AC-DC-AC Tests	COLT	COLT
Layer Quality Test / Bi-Layer Test	COLT	COLT
Fast Pulse & Transient Recording	TRC	TR8M
High Current Interrupt Measurements	PULSE	TR8M
Relaxation Voltammetry	RV	Noise
Controlled Intensity Modulated Photo-Spectroscopy	CIMPS	CIMPS
Programmable Procedures	SCRIPT	-

Most of these methods are available in the standard Thales package and can be used without additional hardware. Some are implemented in Thales but need additional hardware (**NOISE**, **TRC**, **PULSE**, **RV**, **CIMPS** and **COLT**). External potentiostats are connected to the **IM6ex** through **EPC40** cards, each of which can control up to 4 pots. This results in a total of 16 external potentiostats the **IM6ex** can be equipped with.

The IM6ex is controlled by a Windows®-PC which is connected through USB.

* NET is a software option which allows the implementation of external data acquisition and controlling devices via TCP/IP into the Thales environment.

General

Overall bandwidth	DC - 5 MHz	Cell connections	2-, 3-, 4-terminal Kelvin
ADC/DAC resolution	16 bit	PC interface	USB
Extension slots	4	Accessories	U-buffer, USB cable, short cell cable set, long cell cable set, manual
Shell	ground	Dimensions	364 x 160 x 376 mm
Harmonic reject	> 60 dB @ 0.5 full scale	Weight	12 kg
Potentiostat Modes	potentiostatic, galvanostatic, pseudo-galvanostatic, pseudo-rest-potential, off		

Frequency Generator & Analyzer

Frequency range	10 μ Hz to 3 MHz	AC-amplitude	1 mV to 1 V
Frequency accuracy	< 0.01%	Common mode rejection	> 80 dB at 10 μ Hz to 100 KHz
Frequency resolution	0.01%	(differential inputs)	> 60 dB at 100 KHz to 1 MHz
	5000 steps / decade	Impedance range pot.	1 m Ω - 5 G Ω
Input channel phase-tracking accuracy	\pm 0.1 deg at 10 μ Hz to 100 KHz	/w buffer	10 m Ω - 1 T Ω
	\pm 0.25 deg at 100 KHz to 1 MHz	Impedance range galv.	10 μ Ω - 100 M Ω

Internal Potentiostat

DC-Characteristics

Counter electrode	compliance voltage	\pm 14 V (up to \pm 120 V boosted)
	output current	\pm 2 A
Continuous power		28 W
Potential ranges		\pm 1 V, \pm 2 V, \pm 4 V, \pm 10 V
Resolution		64.000 steps / range
Input impedance	without buffer	1 T Ω // \pm 5 pF (typical), 50 G Ω // \pm 5 pF (min.)
	with buffer	10 T Ω // \pm 1 pF (typical), 1 T Ω // \pm 1 pF (min.)
Input current	without buffer	10 pA
	with buffer	12 fA
Voltage temp. stability		< 25 μ V/ $^{\circ}$ C

Dynamic data

Small signal rise time	250 ns to 200 μ s in 5 steps, automatic range selection
Slew rate	15 MV/s
Bandwidth (-3 dB)	3 MHz @ 33 Ω load
Phase shift	10 deg at 200 KHz
Offset voltage	< 100 μ V
Offset temp. stability	< 20 μ V/ $^{\circ}$ C
Equiv. effective input noise	20 μ V rms / 2 pA rms @ 1 mHz - 10 Hz

Potentiostatic mode

Potential range	\pm 4 V (standard), \pm 10 V (extended)	
Resolution	125 μ V (standard), 320 μ V (extended)	
Accuracy	\pm 250 μ V (standard), \pm 1 mV (extended)	
Input current ranges	\pm 1 nA to \pm 2 A in 26 steps, automatic range selection	
	minimum resolution	0.1%
	accuracy	\pm 0.05% at 2 μ A to 200 mA
		\pm 0.5% at <2 μ A or >200 mA
IR Compensation	Method	Auto AC impedance technique
	Positive feedback range	0 to 10 M Ω
	Resolution	0.012% of range

Galvanostatic mode

Current range	\pm 0.1 μ A to \pm 2 A nominal in 24 steps	
	minimum resolution	0.025%
	accuracy	0.1% at >2 μ A to 200 mA
		1% at <2 μ A or >200 mA

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