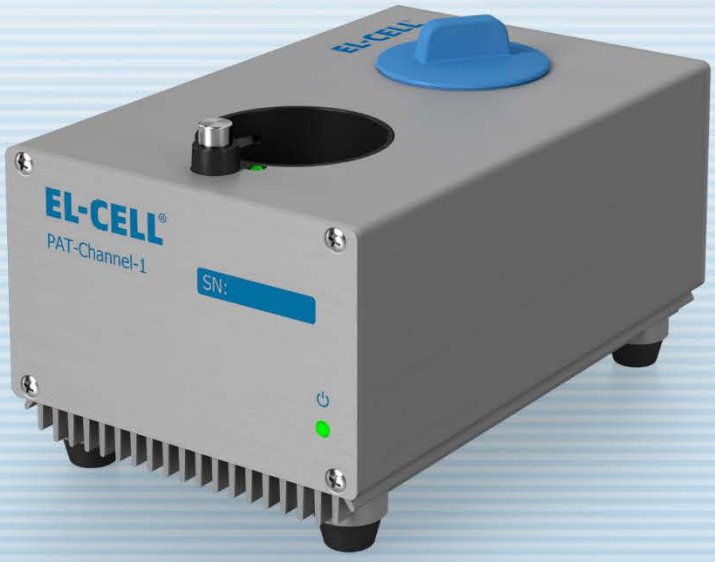
EL-CELL®
electrochemical test equipment

User Manual

Release 1.1

PAT-Channel-1

Single channel station for one battery test cell



Disclaimer

EL-Cell GmbH makes no assurances or warranties with respect to this manual and, to the extent permitted by law, limits its liability for violation of any implied warranty to the substitution of this manual for another. In addition, EL-Cell GmbH reserves the right to revise this publication at any time without notice to anyone.

The information provided in this documentation includes general descriptions and/or technical characteristics regarding the performance of the equipment described herein. This documentation cannot serve as a proper evaluation of the suitability or reliability of the equipment for any specific application by any user and should not be relied upon as a substitute for such evaluation. It is the responsibility of each such user or installer to conduct an appropriate and complete risk assessment, evaluation and testing of the equipment with respect to their specific application. EL-Cell GmbH cannot be held responsible or liable for any misuse of the information contained herein.

All relevant state, regional and local safety regulations must always be complied with when installing and using this device. For safety reasons and to ensure compliance with the documented system data, only the manufacturer is authorized to perform repairs on components.

Disregarding this information may result in injury or damage to the equipment.

Manufacturer and customer service

EL-Cell GmbH

Tempowerkring 8

21079 Hamburg – Germany

Telephone: +49 40 79012-734

Telefax: +49 40 79012-736

Email: info@el-cell.com

Website: el-cell.com

Technical support

Telephone: +49 40 79012-734

Email: support@el-cell.com

Website: el-cell.com/support/technical-support/

Please always quote the serial number on the nameplate when making customer service inquiries.

Shipping address for repairs

EL-Cell GmbH

Tempowerkring 8

21079 Hamburg - Germany

Please be sure to contact our customer service department before making a return. We will not open or process shipments without a completed decontamination report or RMA.

Content

1 Preamble

1.1 Purpose and target audience

This manual describes the structure, function, operation and maintenance of the PAT-Channel-1. It is intended for the end users of the device. An end user can be described as any person who interacts directly with the PAT-Channel-1. The term "end user" usually includes laboratory personnel who have been specifically trained to operate this instrument and are familiar with all the precautions required to work in the laboratory.

Only an authorized and properly qualified and experienced person 18 years of age or older may use the PAT-Channel-1, who:

- has read and understood these installation and operating instructions
- is familiar with the installation and operation of this or a similar device
- is aware of all possible dangers and acts accordingly

1.2 Storage instructions

Make sure you have read and understood the complete instructions and all safety information before using this product. Failure to follow these instructions may result in minor or serious injury.

Follow all instructions. This will prevent accidents that could result in property damage or injury. Keep all safety information and instructions for future reference and pass them on to subsequent users of the product.

The manufacturer is not liable for property damage or injuries resulting from incorrect handling or failure to comply with the safety instructions. In such cases, the warranty becomes void.

1.3 Obtaining documents and information

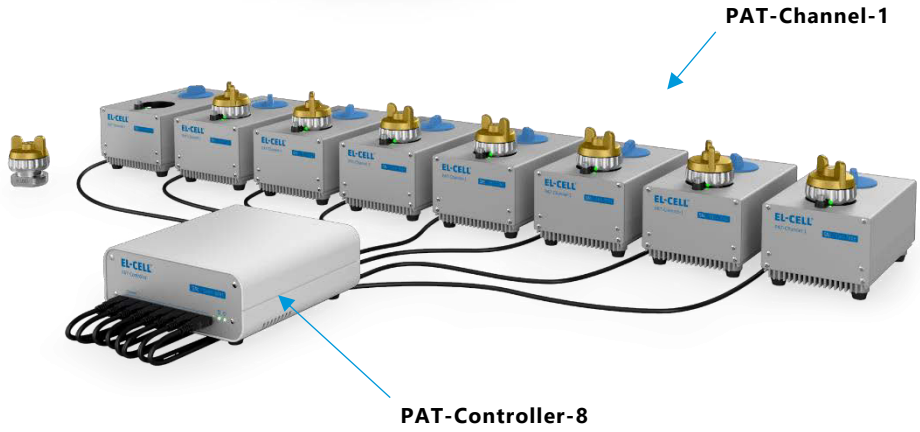
A current version of the documentation is available on the following website:

https://el-cell.com/support/manuals/

Alternatively, you can scan this QR code,
to access the website:

2 Product description

The PAT-Channel-1 is a fully featured, single channel potentiostat / galvanostat/ impedance analyzer which is operated in conjunction with a PAT-Controller. It has a docking socket for one PAT series test cell and external connectors to connect a test cell of a different type or a separate docking station.

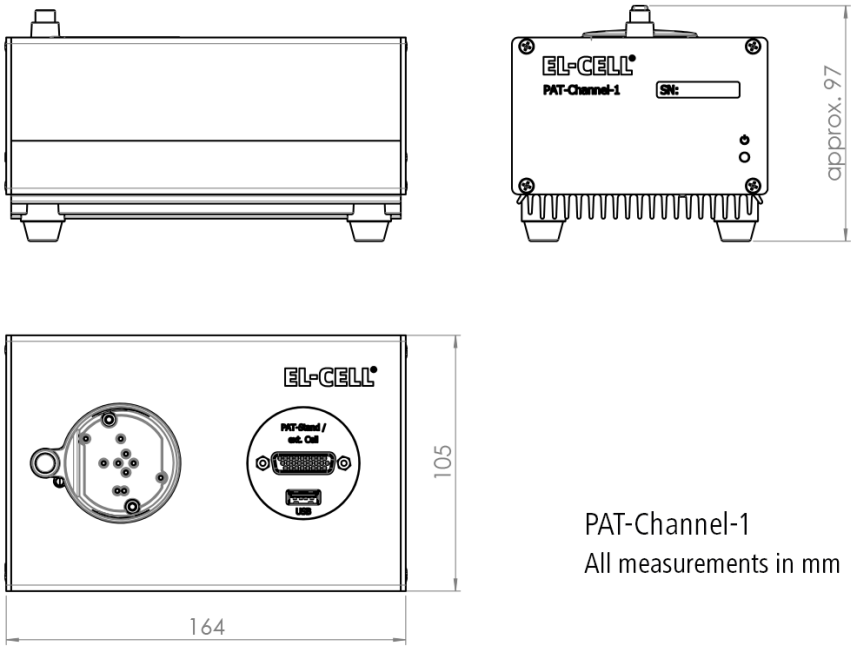


3 Features

- Fully equipped with PStat/GStat/EIS
- PAT docking station
- D-Sub port for active shielded cell cable, I^2C bus signals and analog input
- USB 2.0 port for additional sensor data

4 Technical data

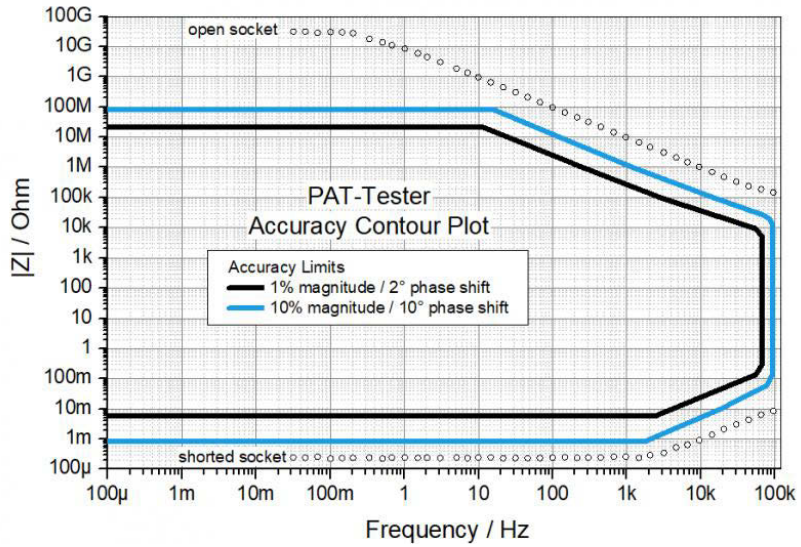
- Height: 97 mm
- Length: 164 mm
- Width: 105 mm
- Weight: 1.3 kg
- Temperature operation range -20 to +40 °C
- Humidity: non condensing



PAT-Channel-1
All measurements in mm

5 Specifications

5.1 Accuracy Contour Plot



5.2 Test channel performance data

General	
Control Voltage	-7 to +7 V
Compliance Voltage	-8 V to +8 V (no load)
Current	±100 mA
Cell and electrode connections	3 electrodes plus sense wires, Connection matrix
ADC	2x24 Bit
DAC	1x18 Bit
Bandwidth ranges	500 kHz 50 kHz 5 kHz
Slew rate	2.5 V/µs
Sampling interval (rate)	1 ms
Input Impedance	>100 MΩ || 20 pF
Computer Interface	1 GBit Ethernet

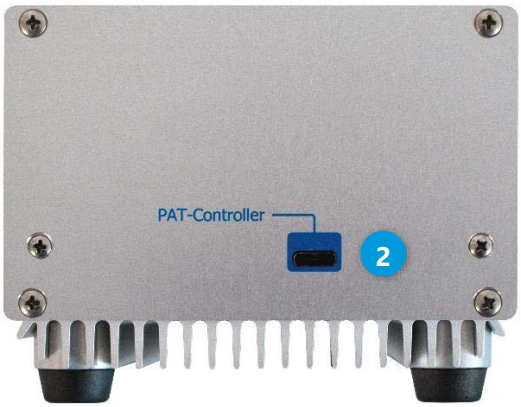
	Runs standalone Multiuser
Voltage	
Acquisition voltages	Full cell voltage Both half cell voltages Auxiliary voltage
Measurement Accuracy	±0.02% FSR (Full Scale Range)
Measurement Noise floor	30 µV peak-peak typical
Control Resolution	57 µV (18 Bit) EIS amplitude: 3 µV (additional 16 Bit DAC for EIS)
Current	
Current Ranges	±100 mA ±10 mA ±1 mA ±100 µA Auto Range
Measurement Noise floor	<1 µA @ 100mA <100 nA @ 10mA <10 nA @ 1mA <1 nA @ 100µA
Measurement Accuracy	±0.05% FSR
Control Resolution	1 nA min. (18 Bit)
Impedance (each channel)	
Frequency range	100 µHz to 100 kHz
Impedance mode	PEIS and GEIS (simultaneous measurement of full- and half-cell impedances)
Impedance range	1 mΩ to 100 MΩ
EIS quality indicator	SFDR (Spurious Free Dynamic Range)
EIS drift correction	yes
EIS adaptive amplitude	yes
Other	
Additional Measurement (each channel)	Digital (I^2C) sensor signal, e.g. for cell temperature Analog sensor signal, e.g. for gas pressure
Calibration	Fully automatic self-calibration with internal voltage reference and three internal calibration cells

Software	EL-Software with : Experiment designer Cell and material management with database Script editor Live data monitoring Analysing and reporting capabilities
Cell Identification	PAT-Button with unique serial number stored in EEPROM

6 Construction and Connections

Front:

Back:



1 **LED Front Panel**

2 **USB 2.0 Hi-Speed, type C connection to PAT-Controller**

Top:

3 **Push button**

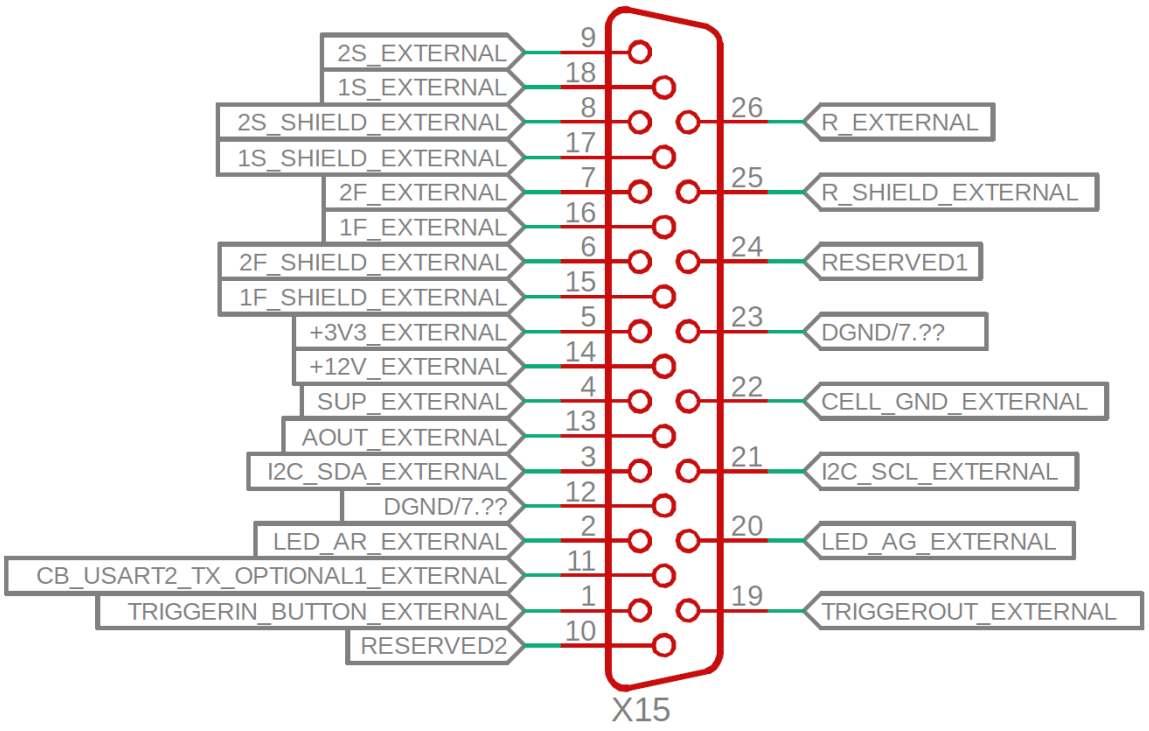
4 **PAT-Socket**

5 **LED Socket**

6 **D-Sub connector**

7 **USB 2.0 port (used for power supply and data transfer of external devices)**

6.1 Pin assignment D-Sub connector



7 LED Signals Overview

LED	Signal	Meaning
Front panel	Red, lighting interval 3 sec	Initialising Mainboard
Front panel	Red, permanent	Mainboard Error
Front panel	Green, permanent	Mainboard operational
Front panel	Blue*, permanent	PAT-Controller is waiting for assignment of an IP address from the DHCP server **or** Establishing USB connection **or** Performing firmware update (Mainboard+Channelboard, can take up to 5 min)
Socket	Red, lighting interval 3 sec	Initialising Channelboard
Socket	Red, permanent	Channelboard Error
Socket	Green, permanent	Channelboard operational

* only available in devices starting from serial number CH1-0169. Older devices may show no sign of life during these operating states.

8 Safety Precautions

WARNING: A WARNING indicates a potential for property damage, personal injury, or death.

Do not operate the device with any cover removed.

Do not use the device in a wet environment. Protect equipment from liquid intrusion.

Do not push any objects into the openings of the device.

Do not operate the device beyond the allowed temperature range stated in the chapter Technical Data.

Do not attempt to service your equipment yourself. In case of technical failure contact our technical support as stated at the end of this manual.

9 Installation

Note: To operate the PAT-Channel-1 you need a PAT-Controller connected to an Ethernet Local Area Network (LAN). EL-Software Server (the server application of EL software) must be installed on the LAN server and EL-Software Client (the client component of EL software) on at least one client PC. The installation instructions for the PAT-Controller and EL-Software can be found in separate manuals.

1. Place the PAT-Channel-1 on a flat, dry and clean surface.

2. Connect the PAT-Channel to the PAT-Controller-8 using the supplied USB cable. The cable connects the USB port on the PAT-Channel (labeled "PAT-Controller") to one of the 8 USB ports (labeled "Channel") on the PAT Controller.

3. Insert a PAT series test cell into the PAT socket, until the cell audibly clicks into place. This ensures that the electrical contact is properly established. To remove a cell, press the push button next to the PAT socket to release the lock and then remove the cell.

Alternatively, connect another cell type or a PAT docking station via the D-Sub connector of the PAT-Channel and a special cable. This option can be used, for example, to operate a test cell at extreme temperatures in a climate chamber. An adapter is optionally available to test coin cells in the PAT socket.

10 Cleaning

Wipe the PAT-Channel-1 with a moist tissue. Do not use aggressive chemicals for cleaning. Protect the device from dust and moisture.

11 Unpacking

Check the contents of the packages against the list given below to verify that you have received all of the required components. Contact EL-CELL, if anything is missing or damaged. **NOTE**: Damaged shipments must remain within the original packaging for freight company inspection.

List of components:

- **PAT-Channel-1**
- **USB cable 2.0, type C, 3m**, ELT9797

12 EC Declaration of Conformity

EL-CELL®

electrochemical test equipment

EU Declaration of Conformity

Manufacturer's name and address:	EL-Cell GmbH Tempowerkring 8 21079 Hamburg Germany
Product:	PAT-Channel-1

The designated product is in conformity with the

- Low Voltage Directive (LDV) 2014/35/EU
- Electromagnetic Compatibility Directive (CEM) 2014/30/EU
- Restriction of Hazardous Substance Directive (RoHS) 2011/65/EU

and the following harmonised standards:

- Safety: IEC 61010-1
- EMC: IEC 61326

Emissions

EN 55011: Conducted Class B
EN 55011: Radiated Class A
EN 61000-3-2: Harmonic Current

Immunity

IEC 61000-4-3: EM field
IEC 61000-4-4: Burst
IEC 61000-4-5: Surge
IEC 61000-4-6: Conducted RF
IEC 61000-4-8: Magnetic Field
IEC 61000-4-11: Voltage Dip/Short Interruptions

Hamburg, 18.09.2020

Michael Hahn, CEO

This declaration certifies compliance with the above mentioned directives but does not include a property assurance.
The safety note given in the product documentation which are part of the supply, must be observed.

The products described are in conformity with the following harmonized standards:

EN 61010-1:2010	Sicherheitsbestimmungen für elektrische Mess-, Steuer-, Regel- und Laborgeräte – Teil 1: Allgemeine Anforderungen (DIN EN 61010-1, VDE 0411-1:2011-07)
	Safety requirements for electrical equipment for measurement, control and laboratory use - Part 1: General requirements (IEC 61010-1:2010 + Cor. :2011)
EN 61010-2-201:2014	Sicherheitsbestimmungen für elektrische Mess-, Steuer-, Regel- und Laborgeräte - Teil 2-201: Besondere Anforderungen für Steuer- und Regelgeräte (DIN EN 61010-2-201:2014, VDE 0411-2-201:2014-01)
	Safety requirements for electrical equipment for measurement, control and laboratory use - Part 2-201: Particular requirements for control equipment (IEC 61010-2-201:2013)
EN 61010-2-010:2015-05	Sicherheitsbestimmungen für elektrische Mess-, Steuer-, Regel- und Laborgeräte - Teil 2-010: Besondere Anforderungen an Laborgeräte für das Erhitzen von Stoffen (DIN EN 61010-2-010:2014; VDE 0411-2-010:2015-05)
	Safety requirements for electrical equipment for measurement, control and laboratory use - Part 2-201: Particular requirements for control equipment (IEC 61010-2-201:2013)
EN 61326-1:2013	Elektrische Mess-, Steuer-, Regel- und Laborgeräte - EMV-Anforderungen - Teil 1: Allgemeine Anforderungen (DIN EN 61326-1:2013-07, VDE 0843-20-1:2013-07)
	EMC requirements - Part 2-3: Particular requirements - Test configuration, operational conditions and performance criteria for transducers with integrated or remote signal conditioning (IEC 61326-2-3:2012)

EN 61326-2-3:2013-07	Elektrische Mess-, Steuer-, Regel- und Laborgeräte - EMV-Anforderungen - Teil 2-3: Besondere Anforderungen - Prüfanordnung, Betriebsbedingungen und Leistungsmerkmale für Messgrößenumformer mit integrierter oder abgesetzter Signalaufbereitung (DIN EN 61326-2-3:2013-07, VDE 0843-20-2-3:2013-07)
	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 2-3: Particular requirements - Test configuration, operational conditions and performance criteria for transducers with integrated or remote signal conditioning (IEC 61326-2-3:2012)
EN 50581: 2013-02	Technische Dokumentation zur Beurteilung von Elektro- und Elektronikgeräten hinsichtlich der Beschränkung gefährlicher Stoffe (DIN EN 50581; VDE 0042-12:2013-02)
	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

13 Warranty

For a period of one year from the date of shipment, EL-Cell GmbH (hereinafter Seller) warrants the goods to be free from defect in material and workmanship to the original purchaser. During the warranty period, Seller agrees to repair or replace defective and/or nonconforming goods or parts without charge for material or labor, or, at the Seller's option, demand return of the goods and tender repayment of the price. Buyer's exclusive remedy is repair or replacement of defective and nonconforming goods, or, at Seller's option, the repayment of the price.

Seller excludes and disclaims any liability for lost profits, personal injury, interruption of service, or for consequential incidental or special damages arising out of, resulting from, or relating in any manner to these goods.

This Limited Warranty does not cover defects, damage, or nonconformity resulting from abuse, misuse, neglect, lack of reasonable care, modification, or the attachment of improper devices to the goods. This Limited Warranty does not cover expendable items. This warranty is void when repairs are performed by a non-authorized person or service center. At Seller's option, repairs or replacements will be made on site or at the factory. If repairs or replacements are to be made at the factory, Buyer shall return the goods prepaid and bear all the risks of loss until delivered to the factory. If Seller returns the goods, they will be delivered prepaid and Seller will bear all risks of loss until delivery to Buyer. Buyer and Seller agree that this Limited Warranty shall be governed by and construed in accordance with the laws of Germany.

The warranties contained in this agreement are in lieu of all other warranties expressed or implied, including the warranties of merchantability and fitness for a particular purpose.

This Limited Warranty supersedes all prior proposals or representations oral or written and constitutes the entire understanding regarding the warranties made by Seller to Buyer. This Limited Warranty may not be expanded or modified except in writing signed by the parties hereto.