



**SWAM 2c**  
Patch-clamp amplifier

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 celica biomedical

# SWAM 2c

## Patch-clamp amplifier with an in-built dual-phase lock-in amplifier

### TECHNICAL SPECIFICATIONS

#### Version 2000-01-4

- Head stage: 20 x 20 x 90 mm (duraluminium)
- Cable: 1.3 m (flexible)
- Controller (main console):  
19" rack mounting; 134 x 487 x 236 mm,  
weight cca. 2.5kg
- Power requirements:  
115 - 230 AC, 50 - 60 Hz, 20 W,  
fuse T 0.6A or T0.3A.

## Conventional patch-clamp measuring modes:

### 1 Voltage-Clamp modes:

- **Noise**  
(8 pole low pass Bessel, RMS, -3dB, 100 GΩ resistor)

330 Hz	25 fA
1000 Hz	40 fA
3300 Hz	100 fA
10000 Hz	240 fA

- **Current monitor output:**  
filtered, Bessel, 8 pole LP,  
-3dB (0.33; 1.00; 3.33; 10.00 kHz)
- **Gain:**  
1 GΩ and 100 GΩ measuring resistors,  
automatically switched from main console  
by gain switch.
- **Range:**  
1 GΩ resistor 20 pA/V to 1 nA/V;  
100 GΩ resistor 10 pA/V to 1 pA/V

- **Risetime**  
1 GΩ resistor 5 μs and with 100 GΩ resistor  
10 μs (5 frequency compensation stages).

- **Audio alarm monitor**  
for head stage and main console electronic  
circuit saturation.

- **Amperometry mode:**  
voltage clamping carbon fibres at ± 1200 mV

### 2 Tracking mode:

Enables membrane sealing observation, sets the average current monitor output to zero value (low speed current-clamp mode).

- **Reset:**  
Speeds current zero setting.
- **Pipette offset potential adjustment:**  
± 100 mV; polarity selection switch.

### 3 Pipette holding potential:

- **Range:**  
± 200 mV, polarity selection switch
- **Pipette potential display**  
3 1/2 digit LCD DVM
- **Pipette potential output:**  
x 10.
- **Stimulus input scaling:**  
0.000, 0.001, 0.010, 0.050, 0.100, -0.100
- **Stimulus input time constant selection:**  
1 and 10 μs.

## 4 Transient signal cancellation: (2 cancellation stages)

- **Fast capacitance range**  
(cancellation of the pipette holder stray capacitance): 0 to 10 pF; 0.5 to 10.0  $\mu$ s.
- **Slow capacitance range**  
(cancellation of membrane capacitance):  
0.01 - 1 pF; 0.1 - 10 pF; 1 - 100 pF
- **Series conductance cancellation:**  
0 - 1  $\mu$ S for 0.1 - 10 pF and 1 - 100 pF range; 0 - 100 nS for the 0.01 - 1 pF range.
- **Optional increment**  
1% of whole slow capacitance range (used in compensated capacitance measurements; see below).

## 5 Series conductance cancellation:

- **Range:**  
0 - 1  $\mu$ S (automatically determined from transient cancellation controls).
- **Compensation level :**  
0 to 90 % for slow (8 kHz) and fast response (30 kHz).

## 6 Current-clamp mode:

Current-clamp and current-clamp and command modes (bandwidth 10 kHz; 1 G $\Omega$  resistor in use only).

- **Holding current range:**  
 $\pm$  1 nA (polarity selection switch).
- **Command input scaling:**  
1 nA/V.

## Capacitance measurement modes:

- **Noise:**  
(1600 Hz, 111.3 mVrms, 100 G $\Omega$  feedback resistor)

30 Hz (4 pole LP Bessel, - 3dB)

12 aFrms

- **Digitally generated sine wave signal and dual-phase lock-in amplifier:**( $\omega = 10000$  or  $5000$ ; 1600 Hz, 800 Hz) amplitude from 1.11 - 111,3 mVrms.
- **Real and imaginary part of admittance monitors:**  
(G, C), filtered, LP, Bessel, 2 pole; full, 30, 10, 3, 1 Hz.
- **Digital phase setting:**  
0.1 degree accuracy.
- **Phase angle display:**  
3 1/2 digit LCD DVM (99.9 degrees).

### Adjust mode:

enables phase setting using an automatic calibrated signal simulating cell membrane capacitance changes (1 % of slow capacitance change; optional 1 M $\Omega$  resistance change).

### Measure mode:

locks the 1% capacitance steps.

### Gate mode:

TTL controlled intermittent capacitance measurement (TTL controls the sine wave generator), can be used as a stand-by mode.

(Specifications subject to change without notice.)



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