MED64-Presto Quick Guide

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1. Introduction

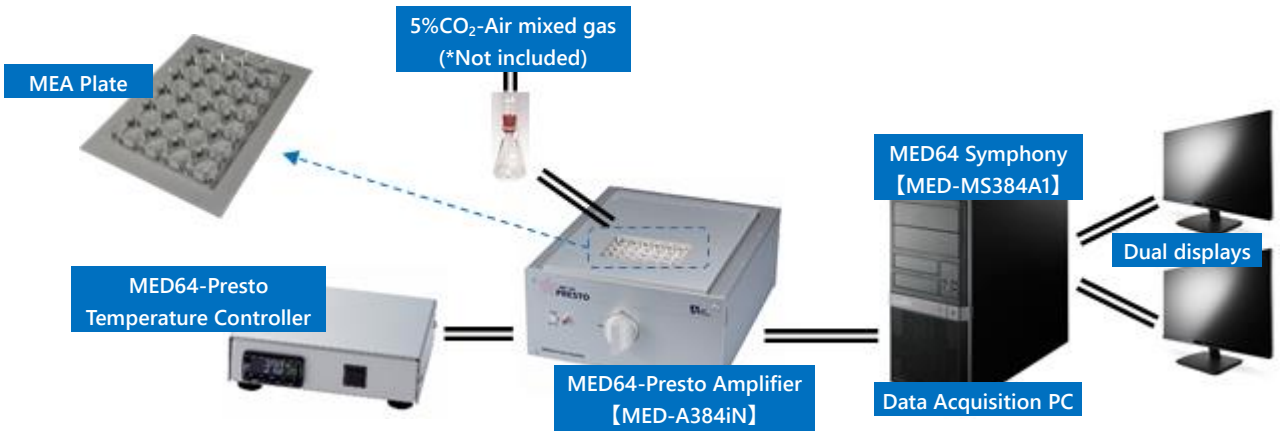
MED64-Presto is a 384-channel microelectrode array (MEA) system, which measures extracellular field potentials by using a dedicated 24- or 48-well plate type MEA. You can culture cells directly on each well where 384 recording electrodes in total are embedded on the whole plate. The electrical activities derived from the cells are detected as extracellular field potential on all 384 electrodes, simultaneously. The dedicated operating software, MED64 Symphony, is intuitively designed and enables online analysis. The temperature controller is also included to maintain a stable medium temperature and a stable CO_2 concentration by continuously inflowing the mixed gas into the MEA cover during data acquisition.

【Features】

- MEA system with 384 channels analog amplifier with high signal-to-noise ratio of 0.9 μV RMS (f < 3 kHz).
- Transparent glass-bottom MEA substrate allows good visibility of cells under an inverted microscope.
- With its built-in heater, a stable experimental condition can be achieved by continuously inflowing the mixed CO_2 gas into the MEA cover.
- With its built-in stimulator, electrical stimulation can be delivered to the specific electrodes in each well.
- Dedicated software MED64 Symphony aquires and analyzes neural and cardiac field potentials in real-time.
- Raw Data opens natively in NeuroExplorer or can be exported for analysis with MED64 Mobius, Python, MATLAB

2. Configuration of the MED64-Presto

MED64-Presto System consists of the following units:



Part Number	Product Name	Remarks
MED-A384iN	MED64-Presto Amplifier	Includes MED64-Presto Temperature Controller
MED-MS384A1	MED64 Symphony	Dedicated software for data acquisition and analysis
MED-Q2430L and others	MEA Plate	24-, 48-well plates available
	PC and dual displays	Prepared by distributors or users. See p.9.

MED64-Presto Amplifier acquires and amplifies the extracellular field potentials detected by each electrode on the MEA Plate. The signal is converted by the MED64-Presto Amplifier's built-in analog-to-digital converter and then sent to the PC via the USB cable. The digital signal is recorded and analyzed online by MED64 Symphony software (offline analysis of recorded data is also possible).

2.1. Components and their functions

2.1.1. MED64-Presto Amplifier

❶POWER ..... To switch ON/OFF of the power.

❷Power indicator ..... LED turns on during the POWER is ON.

❸Locking knob ..... Locks the top plate cover to attach a MEA Plate (the photo shows locked position).

❹Top plate cover ..... Gold-plated spring-loaded pins are embedded in the contact surface with the MEA Plate.

❺EXTERNAL STIMULUS INPUT ..... Input terminal (BNC) to connect to external stimulus equipment.

❻TRIGGER OUTPUT ..... Output terminal (BNC) to control external equipment.

❼USB port ..... To connect the USB cable to the PC.

❽SIGNAL GND ..... A ground terminal to connect a lead for grounding.

❾Cooling fan ..... Cools the amplifier body while recording.

❿HEATER CONTROL INPUT ..... To connect the heater cable.

⓫DC INPUT ..... To connect to the power adaptor cord.

2.1.2. MED64-Presto Temperature Controller

❶Control panel ..... To control the set temperature and displays the current temperature.

❷POWER ..... To switch ON/OFF of the power.

❸OUTPUT ..... To connect the heater cable.

❹DC INPUT ..... To connect to the power adaptor cord.

2.1.3. Accessories

❶DC power supply unit ..... Provides power to the Amplifier or Temperature Controller.

❷Heater cable ..... To connect between the MED64-Presto Amplifier and the Temperature Controller.

❸USB cable ..... To connect between the MED64-Presto Amplifier and the data acquisition PC.

❹MEA Plate cover ..... Acrylic cover to seal the space in the MEA Plate

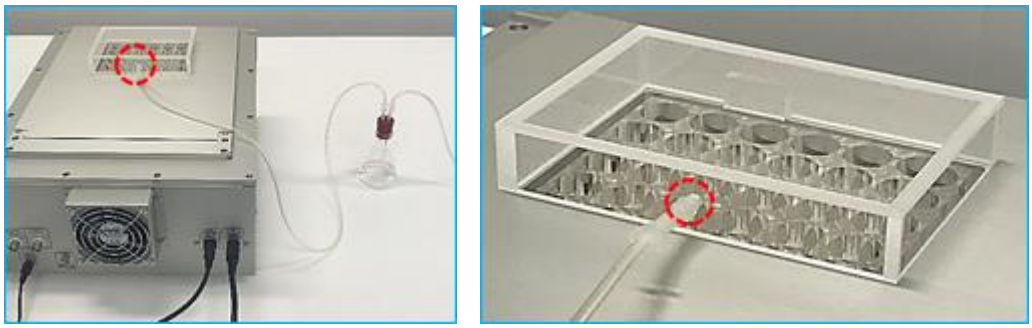
❺Bubbling flask ..... To contain double distilled water for humidifying mixed CO_2 gas by bubbling.

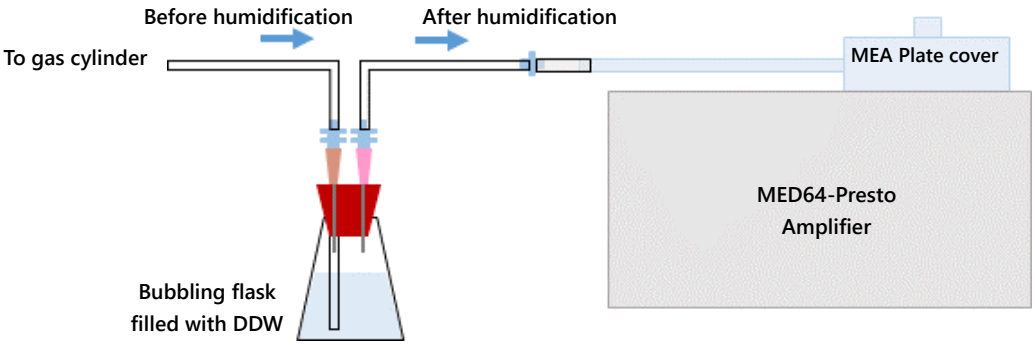
❻Test board ..... The PCB with multiple resistors to check the baseline noise level of the whole system and its environment.

3. Installation

1) Place the MED64-Presto Amplifier and the MED64-Presto Temperature Controller on a stable table without vibrations, such as a laboratory desk. Please avoid placing the system in an area of direct air flow, such as under the direct flow of an air conditioner.
2) Connect all the 3-terminal power plug (MED64-Presto Amplifier, Temperature Controller, data acquisition PC, etc.) to one power strip connected to a wall outlet with the ground terminal (do not use an outlet on the desktop rack because it is often not grounded properly).
3) Connect between MED64-Presto Amplifier and the data acquisition PC with the USB cable.
4) Connect between MED64-Presto Amplifier and the MED64-Presto Temperature Controller with the heater cable.

5) Connect the MEA Plate cover and the bubbling flask with the tubing. During the experiment, seal the space in the MEA Plate with the cover, and maintain the CO_2 concentration inside by continuously flowing mixed gas such as 5% CO_2-Air into the inside. The backside of the MEA Plate cover has an access port for gas supply, and a tube for guiding can be connected to it. If the mixed gas is supplied directly inside the space, the humidity in the space will decrease, which may cause the medium to evaporate. Therefore, supply the mixed CO_2 gas bubbled in the flask filled with DDW.





4. Preparations for the data acquisition

1) Turn on the MED64-Presto Temperature Controller. The measured temperature is displayed on the left side (white), and the set temperature is displayed on the right side (green).

2) Wait until the measured temperature is stable around set temperature (it can take up to 20 minutes). Press the up or down arrows, buttons ❶ and ❷, to change the set temperature.
3) Turn on the data acquisition PC and the MED64-Presto Amplifier.
4) Open the top plate cover and place the MED plate onto the installation frame of the main body. After covering the top plate cover, lock the locking knob while holding down the top plate cover.

5) Seal the MEA Plate cover with its cover and start inflowing mixed CO_2 gas.

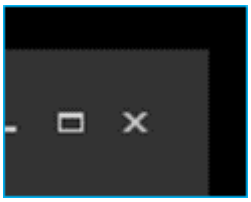
6) Confirm that any noise is not induced by contact failure between the terminal and the pins by checking the baseline noise level, and then start the data acquisition (Please refer to the next chapter, 5. Data acquisition by the control software "MED64 Symphony")

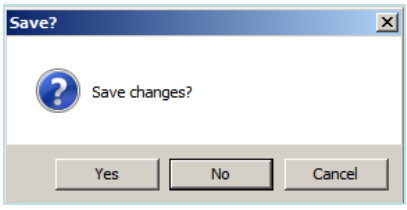
5. Data acquisition by the control software "MED64 Symphony"

In this section, regarding the basic operation of the MED64 Symphony, how to acquire raw data and export the converted data is described (please see "MED64 Symphony Tutorial" in the details).

5.1. Starting and closing MED64 Symphony

Double-click the "Symphony Mini-launcher" icon on the desktop to lunch the Symphony. To close the Symphony, click close button at the upper-right corner of the window. Then a pop-up window appears to confirm whether each setting should be saved. When you select "Yes", the settings will be saved.



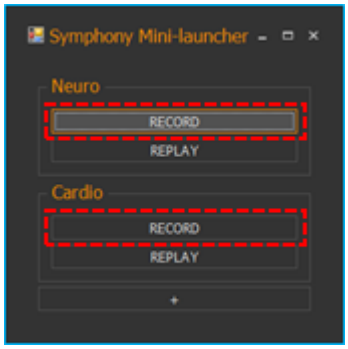


5.2. Checking the baseline noise

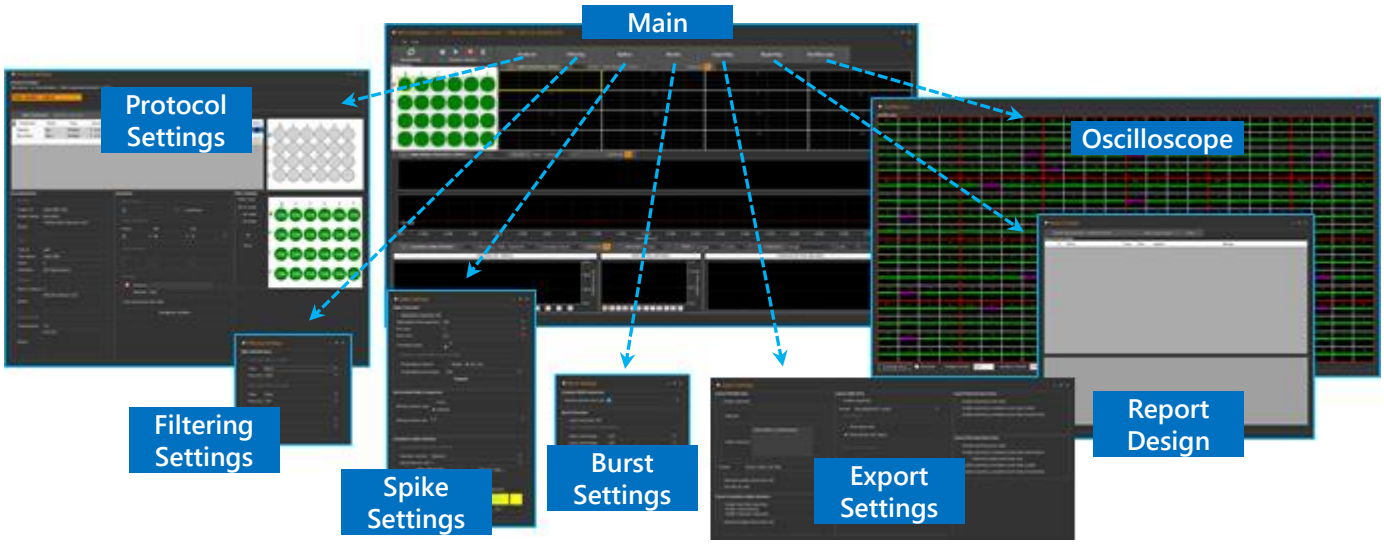
After attaching the MEA Plate onto the MED64-Presto Amplifier, check that no problems such as contact failure have occurred, i.e., baseline noise is normal.

1) Double-click the Symphony Mini-launcher icon.

2) Click "RECORD" of Neuro or Cardio on the Symphony Mini-Launcher window popped up.

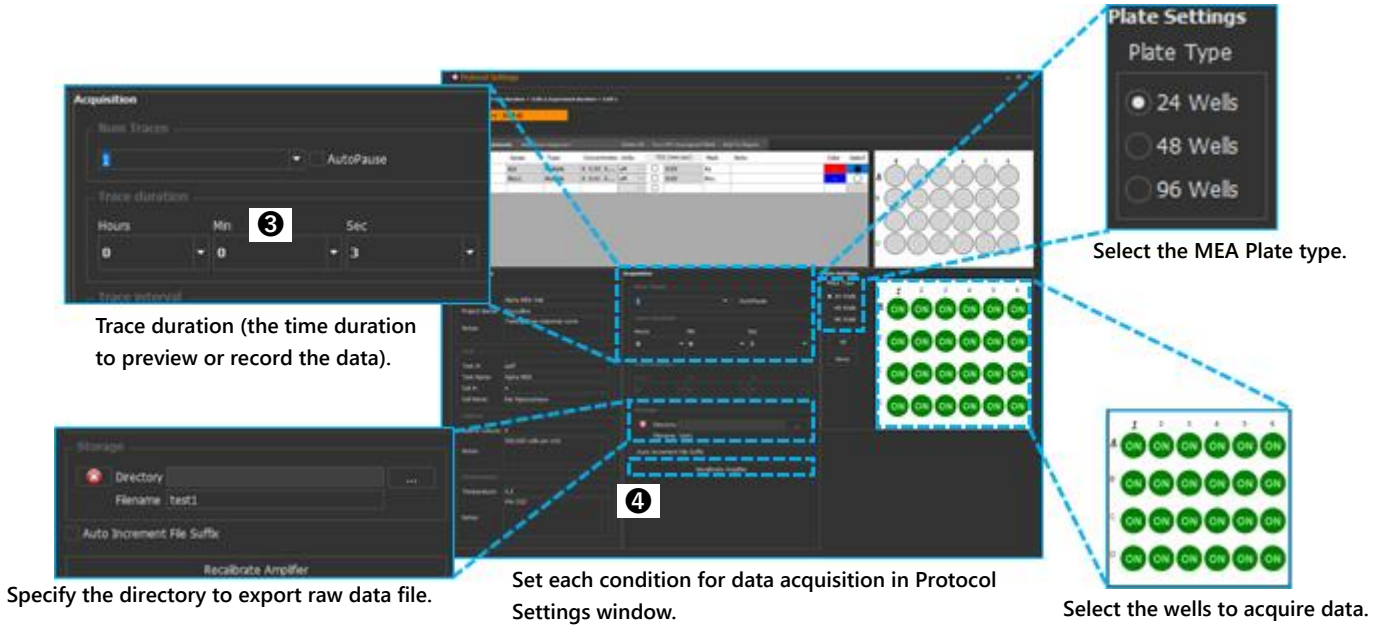


3) The main window of the Neuro or the Cardio workflow will be opened in Record mode (In this example, Neuro workflow is used). Click "Preview" (❶) on the command bar to sweep the baseline noise on charts without exporting the data file.

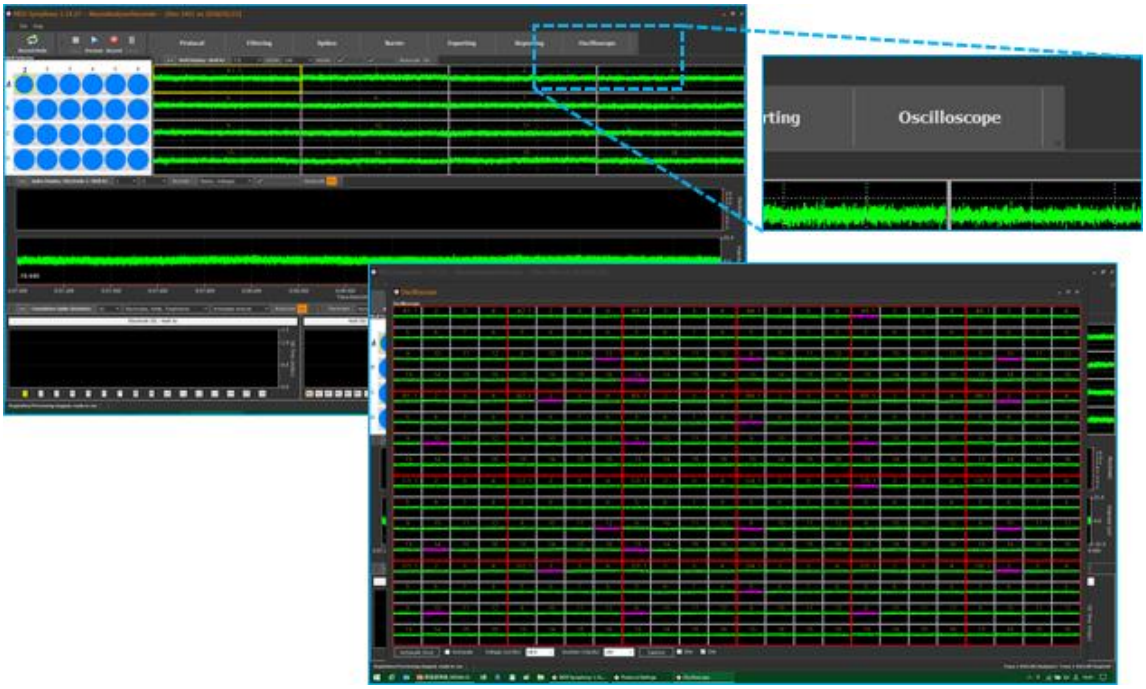


Click a button on the command bar to open each setting window; Protocol, Filtering, Spike, Burst, Exporting, Reporting, and Oscilloscope.

The default setting of the "Trace duration" (time duration of data acquisition) is 20 minutes. To change this value, click "Protocol" (❷) on the command bar and open the window. Then input new value in Trace duration (❸) of Acquisition field.



4) Click "Oscilloscope" on the command bar to open the window (384-channel oscilloscope screen).



The amplitude of normal baseline noise has about ±5 μV peak-peak value without any filtering. When the baseline noise level consistently shifts from the level of 0 μV, click "Stop" on the command bar to stop the data acquisition. Open the Protocol Settings window to click "Recalibrate Amplifier" (❹), and then click "Preview" again to check the recalibrated baseline.

5.3. Exporting of the data file (.modax file)

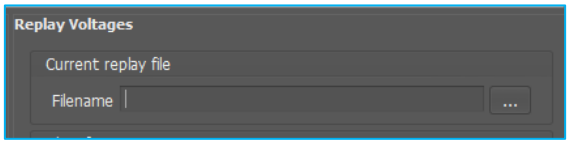
Click "Record" ,not "Preview", to start the data acquisition for recording means exporting the data file with online previewing the data. The original data file format for MED64 Symphony is ".modax". The size of the data file in the all 384 electrodes on is 15.36 MB/s (about 9.2GB for 10 minutes).

5.4. Exporting of the format-converted data file (.modat file)

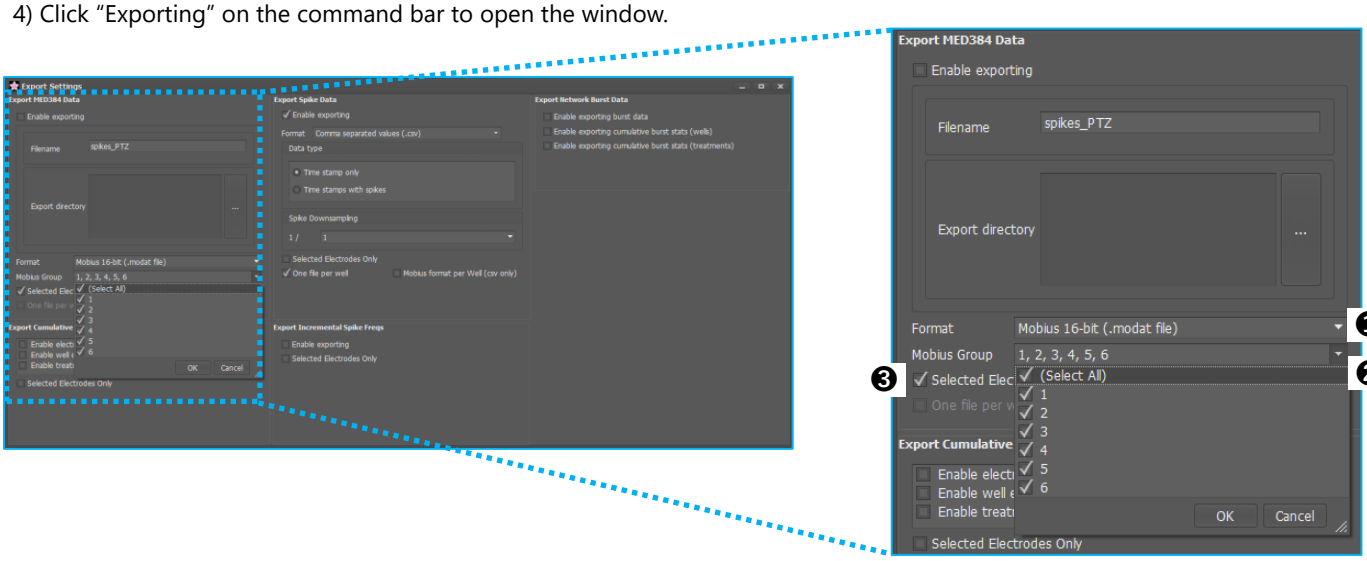
The Symphony can converted a .modax file into ".modax" file, the original data file format for MED64 Mobius, to analyze it by the Mobius or related offline analysis tools. Though the Symphony is able to process a file conversion exporting online while

recording, it is recommended to do that offline after the recording to avoid the impact of increased load on the processing.

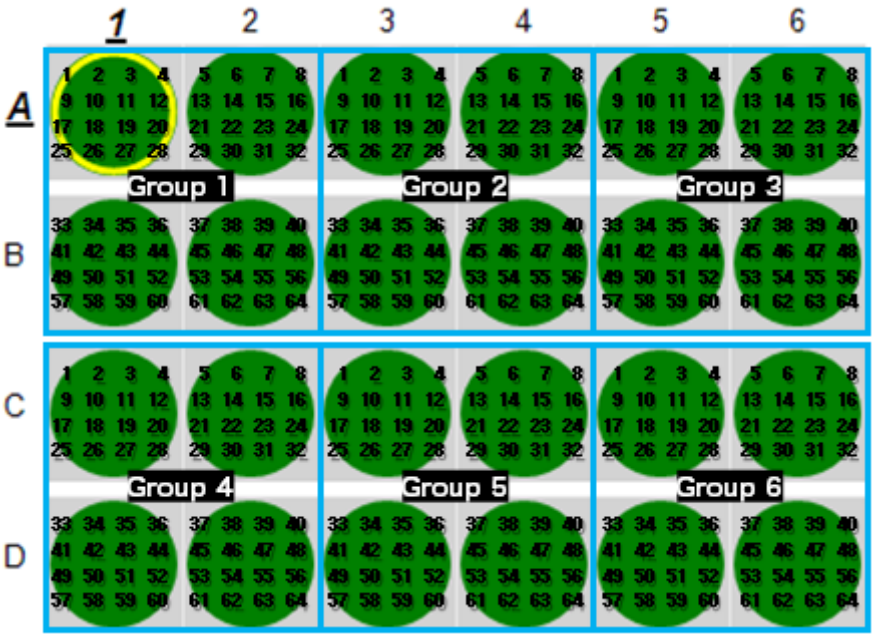
1) Double-click Symphony Mini-launcher icon.
2) Click "RECORD" of Neuro on the Symphony Mini-Launcher window popped up.
3) Open the Protocol Settings window, and then click the "…" box on the right to the "Filename" text box in the Replay Voltages field to choose a .modax file to be converted.



4) Click "Exporting" on the command bar to open the window.



5) Select the converting file format (❶) and the well group (❷). The 384 electrodes data will be grouped into 6 .modat files according to the well as the below. Do not check "Selected Electrodes Only (❸)" to export the data for all electrodes in a selected group.
6) Click "Record" to start the file conversion exporting.



6. Appendix

6.1. Specifications

MED64-Presto Amplifier

Analog Amplifier	
Number of channels	384
Input impedance	100 MΩ
Input leakage current	30 pA
Gain	X 1000
Bandwidth	0.1 Hz - 5 kHz
Input referred noise (Short-circuited between Input terminals)	13 nV (√‾Hz)
Maximum permitted input	±5 mVp
A/D Converter	
Number of channels	384
Sampling rate	20 kHz
Resolution	16 bits
Maximum permitted input	±5 Vp
Built-in Stimulus Amplifier	
Number of channels	1
Sampling rate	100 kHz
Resolution	16 bits
Output type	Voltage drive
Stimulus electrodes	Switchable between 1 electrode (unipolar) and 2 electrodes (bipolar) stimuli
Maximum output voltage	±2 Vp
External Stimulus Amplifier	
Number of input channels	1
Maximum input voltage	±4 Vp
Output type	Voltage drive
Stimulus electrodes	Switchable between 1 electrode (unipolar) and 2 electrodes (bipolar) stimuli
Input/Output voltage ratio	2 : 1
Maximum output voltage	±2 Vp
Digital Control Output	
Number of terminals	1
Output current	4 Vp
Connector	
Contact pin type	1.4 mm stroke spring probe
Contact pin material	Gold plating
Number of contact pins	432 (48 are for Ref electrodes)
DC power unit	
Input voltage	AC 100 - 240V, 50/60Hz
Output voltage	DC ±12V
Output power	30W
System Environment	
Temperature	20 - 30 °C (Recommendation: 25 °C)
Humidity	< 60%

MED64-Presto Temperature Controller

Temperature Controller	
Heater	Transistor (×4)
Thermo sensor	Sensor IC
Temperature controller	OMRON E5GC
Temperature control range	32 - 37 °C (Ta = 25 °C)
Accuracy	±0.1 °C
General	
Amplifier power supply voltage	DC ±12 V
Amplifier power consumption	25 W
Amplifier size	W300 × H200 × D400 mm
Temperature controller power supply voltage	DC ±12 V
Temperature controller power consumption	30 W
Product dimensions	W150 × H50 × D110 mm
DC power unit x2	
Input voltage	AC 100 - 240 V (50/60Hz)
Output voltage	DC ±12 V
Output power	60 W

Requirements: Data Acquisition PC System

CPU	Intel Core i7
Computer memory size	16GB
Drive size for OS	1TB SSD
Drive size for DATA	> 1TB SSD
Display monitor	Resolution: 1920 × 1020 (×2)

MED64 Symphony

＜Features and functions＞

Data acquisition (Resolution 16 bits, Sampling rate 20 kHz, 384 channels)

Oscilloscope for 384 electrodes

Control of voltage-driven stimulation

Data conversion exporting with various file formats (Mobius, NeuroExplorer, csv, and binary)

Noting the treatment information to a data file

Digital filtering (Butterworth highpass, Butterworth lowpass, and Bessel lowpass)

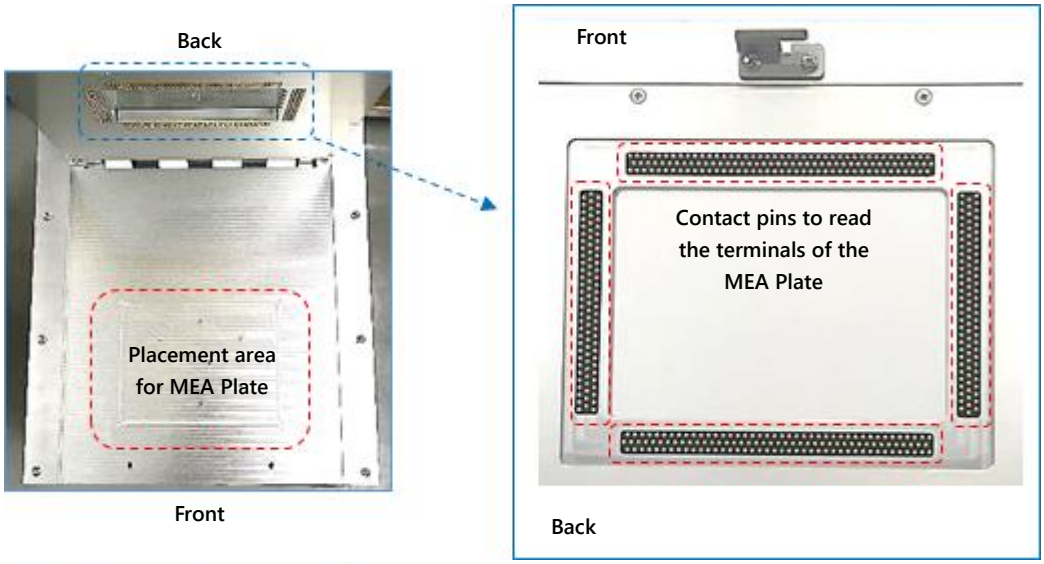
Creating the experiment report

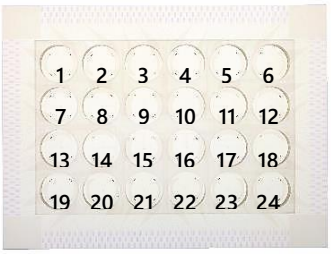
Various on/offline analysis function for neural spikes

Various on/offline analysis function for cardiac signals

6.2. Correspondence between the contact pin and the electrode number.

Spring-loaded pins embedded in the contact surface with the terminal of the MEA Plate correspond to the terminal leads one by one. Also, the electrode number displayed on the Symphony corresponds to the positioning of the pin which defines the electrode number.

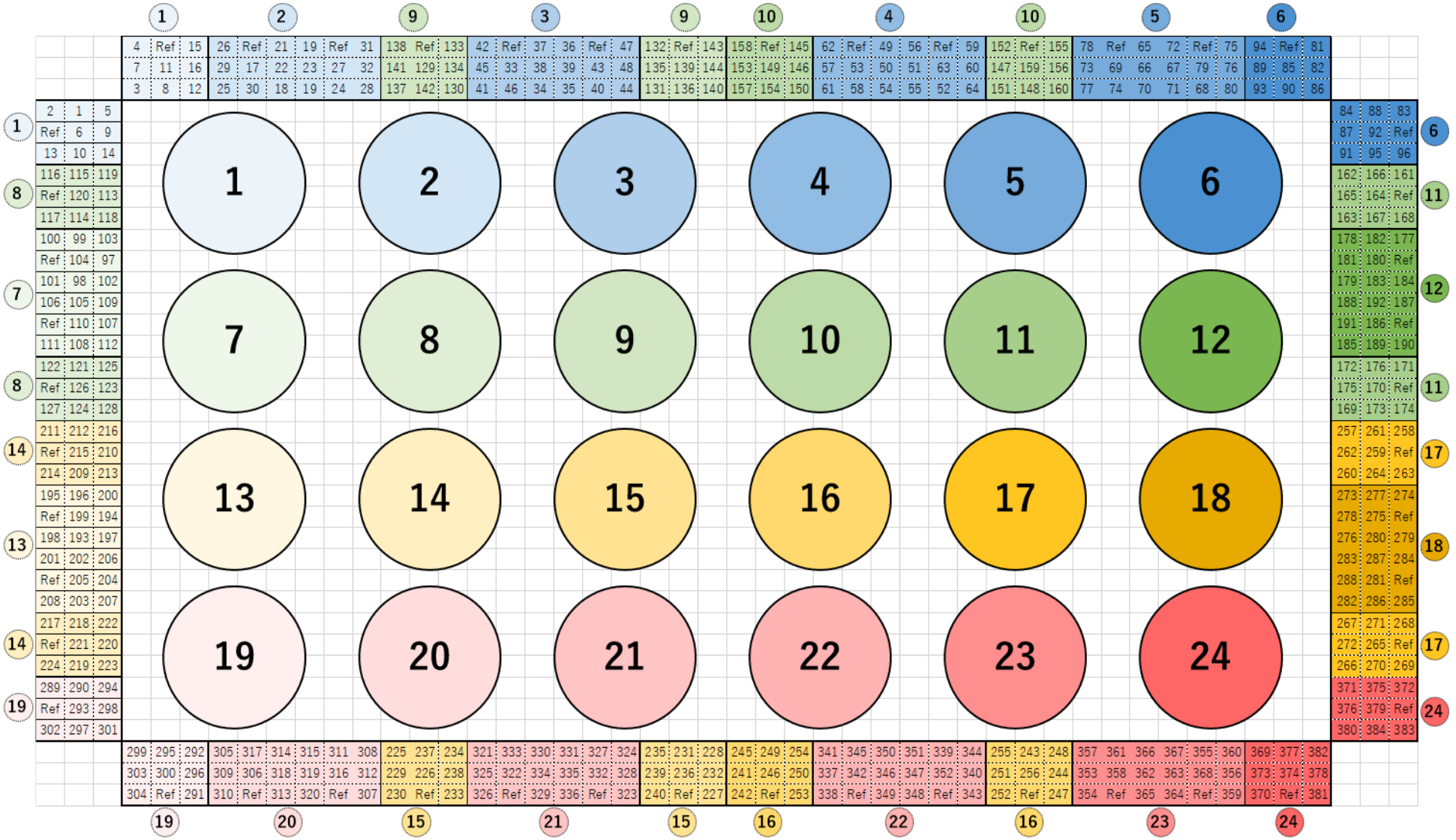




The position of the wells and electrodes displayed on MED64 Symphony is defined by the orientation of MEA Plate placed on the MED64-Presto Amplifier.

Electrodes Arrangement in each well (e.g. : 1 well)

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16



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