

MED64

The most sensitive microelectrode array system for *in vitro* extracellular electrophysiology



Record high-quality extracellular signals with the industry's most sensitive microelectrode array

MED64 Systems are user-friendly microelectrode array (MEA) systems for *in vitro* electrophysiology. Acute or cultured biological preparations are placed or grown directly on a grid of 64 planar microelectrodes. MED64 microelectrodes serve a dual purpose: record field potentials at each electrode and deliver stimulation via any electrode.

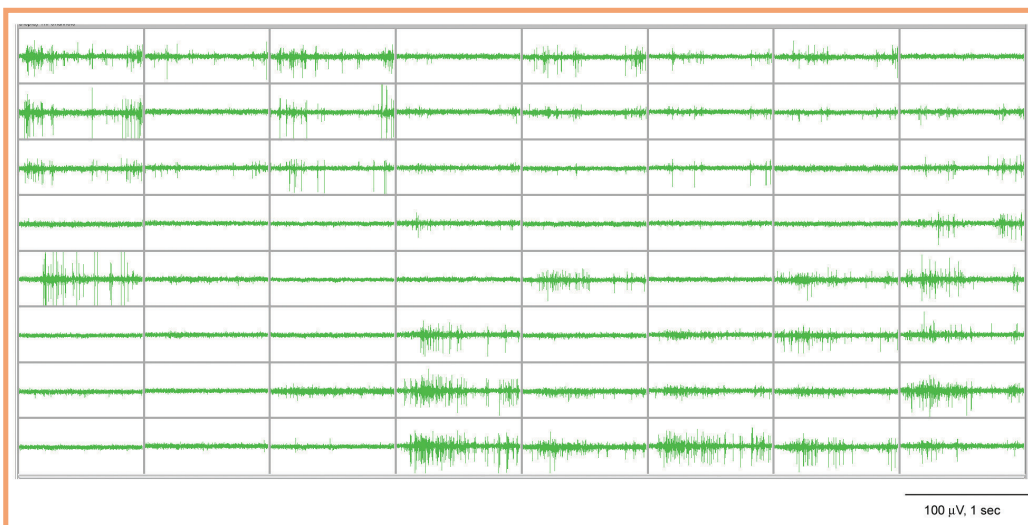
Started by Panasonic, the MED64 has been on the market for 20 years with hundreds of users and publications worldwide.

FEATURES

- Unrivalled signal-to-noise ratio with 0.8 μV RMS noise level.
- Good-quality evoked signals with small stimulus artifacts.
- Large current-driven stimulation via any electrode.
- No need for blanking circuit (which can mask important parts of your data).
- Only MEA system to allow recording in a humidified incubator.
- One system can be used for multiple experiments with its amplifier's broad acquisition bandwidth and analog high/low-pass filter.
- Full-feature MEA software with complete manual/automated acquisition and analysis capabilities.
- Several accessories to support your experiments.
- Various applications validated by hundreds of publications.
- Extraordinary technical support based on our decades of experience.

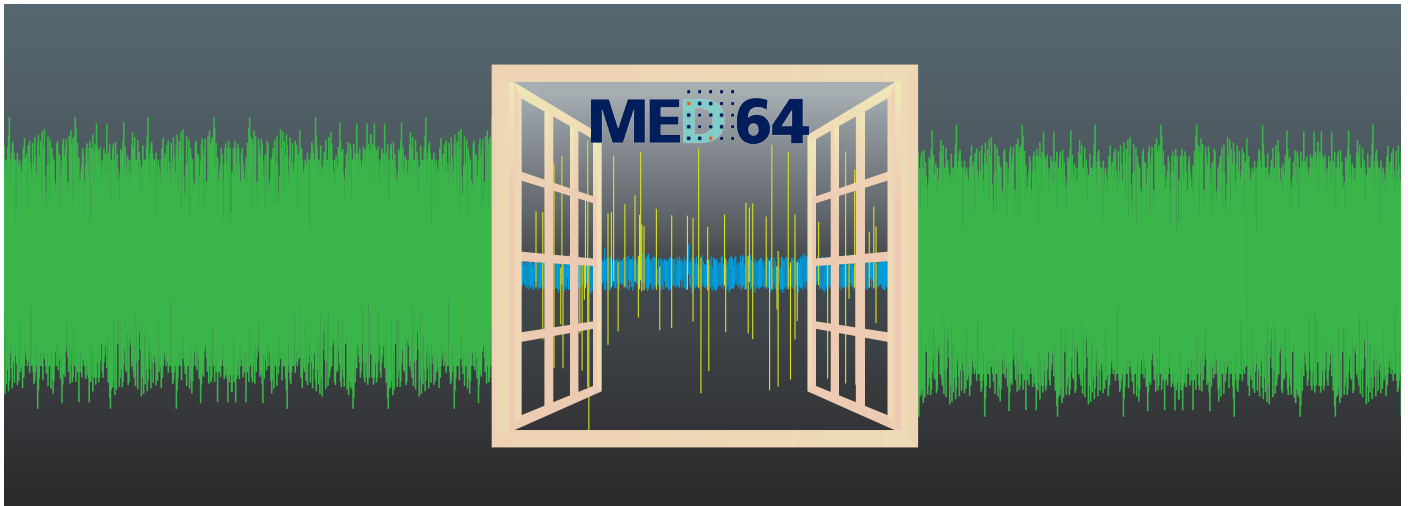


MED64-Basic



Spontaneous neuron spikes

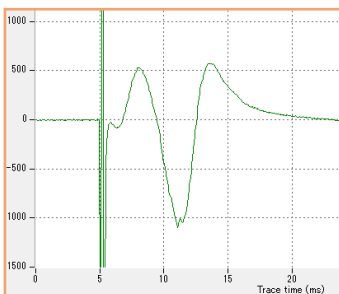
Reveal important extracellular signals that can be hidden by other systems!



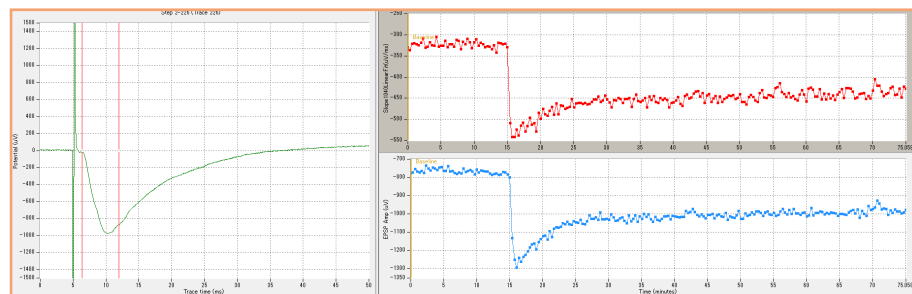
The MED64 features the industry's lowest-impedance planar microelectrodes ($10\text{ k}\Omega$ at 1 kHz), which provides an unrivaled signal-to-noise ratio. Small signals that cannot be detected by other systems can be clearly detected with the MED64.

The MED64's low-impedance electrodes allow for a unique breakthrough configuration where the MED Probe (MEA) is separated from the head amplifier, allowing active recording inside of a humidified incubator.

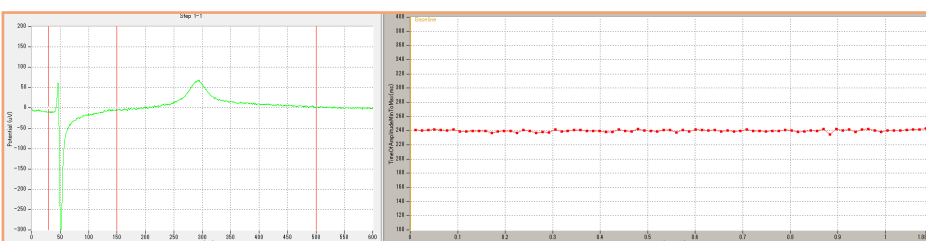
The MED64's high-capacitance electrodes ($0.022\text{ }\mu\text{F}$ for $50\text{ }\mu\text{m}$ electrode) enable large current-driven stimulation (up to $200\text{ }\mu\text{A}$) and very small stimulus artifacts. Clean and high-quality evoked signals can thus be acquired soon after stimulation without interference, and a blanking circuit is unnecessary. The superior evoked signal quality of the MED64 has been demonstrated in hundreds of peer-reviewed publications.



Recording of evoked potentials that occur right after stimulus artifacts



LTP Experiment



Field Potential Duration

SYSTEM LINE-UP

MED64-Basic

Basic system suitable for all applications (Acute slices, Cultured cells, Slice cultures)

FEATURES:

- Signal acquisition from all 64 electrodes simultaneously.
- Stimulation with any of the 64 electrodes (up to 2 electrodes simultaneously).
- Suitable for acute slices, slice cultures, and cell cultures.
- Low-cost upgrade to the MED64-Allegro/Quad II System.

System Configuration:

MED Probe	1
MED Connector (MED-C03 / MED-CP04)	1
MED64 Head Amplifier (MED-A64HE1S)	1
MED64 Main Amplifier (MED-A64MD1)	1
Data Acquisition PC	1
Mobius Software	1



MED64-Allegro

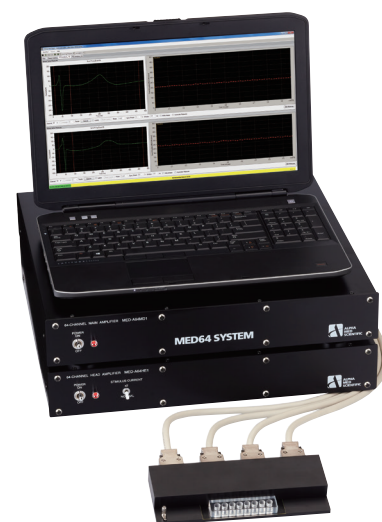
Medium throughput system with multiple wells. Ideal solution for drug testing using stem cell derived-cardiomyocytes/neurons

FEATURES:

- Signal acquisition from 4 or 8 samples (16 electrodes per sample for 4 well / 8 electrodes for 8 well).
- Stimulation through 1 or 2 electrodes per sample sequentially.
- Suitable for cell cultures.
- Low-cost upgrade to the MED64-Quad II or from Basic Sytem.

System Configuration:

MED Multi-well Probe (MED-P5NF30 / P5N811)	1
MED Multi-well Connector (MED-C11)	1
MED64 Head Amplifier (MED-A64HE1S)	1
MED64 Main Amplifier (MED-A64MD1)	1
Data Acquisition PC	1
Mobius Software	1



MED64-Quad II

Medium throughput system for all applications. Ideal solution for drug discovery using brain slices

FEATURES:

- Signal acquisition from 4 samples (16 electrodes/sample).
- Stimulation to all samples sequentially.
- Suitable for acute slices, slice cultures, and cell cultures.
- Low-cost upgrade to the MED64-Allegro or from Basic System.

System Configuration:

MED Probe 16 (MED-PG515A / MED-PG5001A)	4
MED Duet Connector (MED-C05)	2
or MED Mini Connector (MED-C04)	4
MED64 Head Amplifier (MED-A64HE1S)	1
MED64 Main Amplifier (MED-A64MD1)	1
Data Acquisition PC	1
Mobius Software	1



MED64-Plex 4/8

Medium throughput system for recording from 64 electrodes on 4 or 8 samples

FEATURES:

- Signal acquisition from 4 or 8 samples (64 electrodes per sample).
- Stimulation through 1 or 2 electrodes per sample sequentially.
- Suitable for cell cultures and slice cultures.

System Configuration (for Plex 4 System):

MED Probe	4
MED Connector (MED-C03 / MED-CP04)	4
MED64 Head Amplifier (MED-A64HE1S)	1
MED64 Main Amplifier (MED-A64MD1)	1
MED64 Multiplexer I (MED-A64SF1)	1
Data Acquisition PC	1
Mobius Software	1

System Configuration (for Plex 8 System):

MED Probe	8
MED Connector (MED-C03 / MED-CP04)	8
MED64 Head Amplifier (MED-A64HE1S)	1
MED64 Main Amplifier (MED-A64MD1)	1
MED64 Multiplexer I (MED-A64SF1)	1
MED64 Multiplexer II (MED-A64SF2)	1
Data Acquisition PC	1
Mobius Software	1



COMPARISON CHART

	Number of samples	Number of electrodes/ sample	Applications		
			Acute slices	Slice cultures	Cell cultures
MED64-Basic	1	64	○	○	○
MED64-Quad II	4	16	○	○	○
MED64-Allegro	8 (or 4)	8 (for 8 well) / 16 (for 4 well)	x	○(4 well) / x(8 well)	○
MED64-Plex 4/8	8 (or 4)	64	Δ	○	○

Amplifier

MED64 Main Amplifier (MED-A64MD1)

- Main amplifier compatible for all MED64 Systems.
- Broad acquisition bandwidth of 0.1 Hz -10 kHz.
- Low-cut filter (High-pass filter) with 0.1, 1, 10, and 100 Hz cutoff.
- High-cut filter (Low-pass filter) with 1.0, 2.0, 2.5, 5.0, 7.5, and 10 kHz cutoff.
- Built-in digitizer (20 kHz sampling rate, 16 bit resolution)
- USB connection to computer.



MED64 Head Amplifier (MED-A64HE1S)

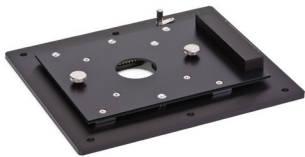
- Head amplifier compatible for all MED64 Systems.
- Built-in 2 channel stimulator.
- 64ch x 1 and 16ch x 4 input terminals allowing connection to all types of connectors.



MED Connectors

MED Connector (MED-C03)

- Used for communication between the MED Probe and the MED64 Head Amplifier.
- Compatible for MED64-Basic and Plex 4/8 Systems.
- No active onboard electrical circuitry; Connectors can safely be placed in a humidified environment (e.g. cell culture incubator).
- Provides clear optical path through MED Probe for microscopy.



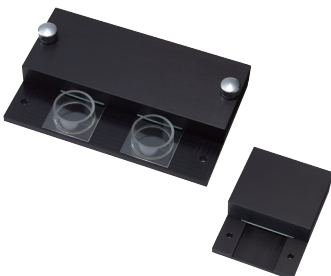
MED ThermoConnector (MED-CP04)

- Heater and thermo sensor are incorporated into the bottom unit of the MED Connector.
- Bath temperature in the MED Probe is maintained using a dedicated temperature controller.
- Can be used with or without perfusion. Included tubing through connector provides in-line solution heating.
- Aperture in the unit bottom allows observing biological samples with microscope.



MED Duet Connector (MED-C05) / MED Mini Connector (MED-C04)

- Connector for the MED64-Quad II System.
- Used for communication between the MED Probe 16 and the MED64 Head Amplifier.
- No active onboard electrical circuitry; Connectors can safely be placed in a humidified environment (e.g., cell culture incubator).
- Compact design. Easy-to-load MED Probe.
- The Duet Connector is compatible with all types of MED Probe 16; whereas, the Mini Connector must be pre-configured for either the 4x4 or 2x8 array Probe.



MED Multi-well Connector (MED-C11)

- Connector for the MED64-Allegro System.
- Used for communication between the MED Multi-well Probe and MED64 Head Amplifier.
- No active onboard electrical circuitry; Connectors can safely be placed in a humidified environment (e.g. cell culture incubator).
- Compact design. Easy-to-load the MED Probe.



Multiplexer

MED64 Multiplexer (MED-A64SF1 / MED-A64SF2)

- Multiplexer used for the MED64-Plex 4/8 System.
- Allows time-sequenced acquisition from 4 or 8 samples.



Accessories

For perfusion:

Perfusion Cap (MED-KCAP01)

- Neatly fits on to the top of a MED Probe.
- Features adjustable solution inflow and outflow pipes, a platinum reference electrode, and a port for delivery of gas.
- Easily removed and replaced for slice mounting.
- Suitable for MED Probes with 10 mm chamber height.
- Pre-configured perfusion tubing available for immediate use.



Perfusion Pipe Holder Kit (MED-KPK02)

- Installed onto the MED Connector or MED ThermoConnector.
- Features adjustable solution inflow and outflow pipes, and a platinum reference electrode.
- Suitable for MED Probes with 5 mm chamber height.
- Pre configured perfusion tubing available for immediate use.



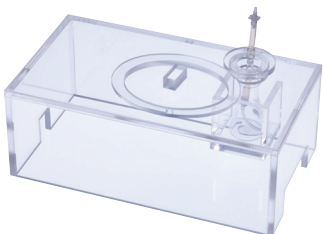
For temperature control:

MED64 ThermoBase (MED-CPB01)

- Heating pad for 1 MED Multi-well connector, 1 MED Duet Connector, or 2 MED Mini Connectors.
- Bath temperature in the MED Probe is maintained using a ThermoClamp® controller manufactured by AutoMate Scientific, Inc.

MED Connector Cover (MED-CC06 / MED-CC02 / MED-CC03)

- Covers the entire MED Connector and helps to maintain the bath temperature in the MED Probe.
- Built-in oxygen port.
- Easy drug delivery port on top of the lid.
- Available with 3 different sizes to fit all types of Connectors. (MED-CC06 for MED-CP04 / MED-CC02 for MED-C04 or MED-C05 / MED-CC03 for MED-C11).



MED Probe

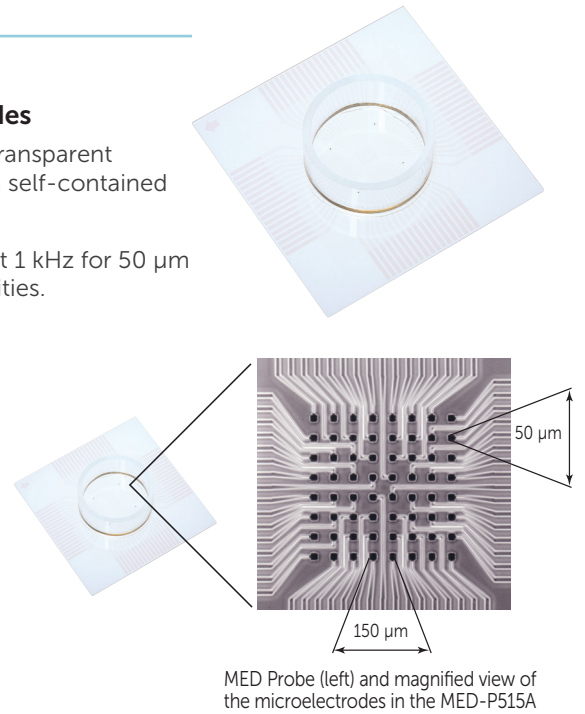
Microelectrode array with the industry's lowest-impedance electrodes

The MED Probe has 64 planar microelectrodes embedded in the center of a transparent glass plate. The surrounding glass (or plastic) cylinder makes the MED Probe a self-contained recording chamber.

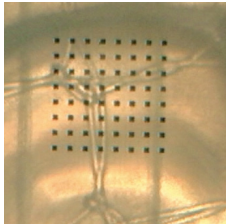
The MED Probe features the industry's lowest-impedance electrodes (10 k Ω at 1 kHz for 50 μ m electrodes). It provides excellent signal-to-noise ratio and stimulation capabilities.

STANDARD 8x8 ARRAYS

Product Number	Array Size	Recording Electrodes		Reference Electrodes		Chamber Depth
		Size	Spacing	Type	Spacing (d)	
MED-P2105	0.7 x 0.7 mm	20 x 20 μ m	100 μ m	A	8.5 mm	5 mm
MED-P210A	0.7 x 0.7 mm	20 x 20 μ m	100 μ m	A	8.5 mm	10 mm
MED-P5155	1 x 1 mm	50 x 50 μ m	150 μ m	E	12 mm	5 mm
MED-P515A	1 x 1 mm	50 x 50 μ m	150 μ m	E	12 mm	10 mm
MED-P5305	2 x 2 mm	50 x 50 μ m	300 μ m	B	9.2 mm	5 mm
MED-P530A	2 x 2 mm	50 x 50 μ m	300 μ m	B	9.2 mm	10 mm
MED-P5455	3 x 3 mm	50 x 50 μ m	450 μ m	B	10.2 mm	5 mm
MED-P545A	3 x 3 mm	50 x 50 μ m	450 μ m	B	10.2 mm	10 mm

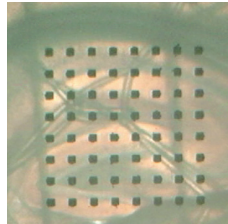


MED-P210A/5 (0.7 mm)



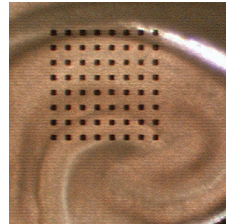
Mouse Hippocampus CA1

MED-P515A/5 (1 mm)



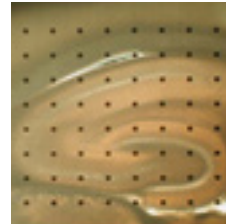
Mouse Hippocampus

MED-P515A/5 (1 mm)



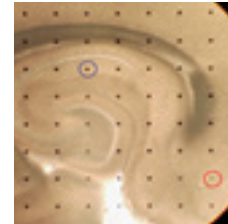
Rat Hippocampus CA1

MED-P530A/5 (2 mm)



Rat Hippocampus

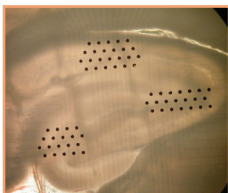
MED-P545A/5 (3 mm)



Rat Hippocampus and peripheral area

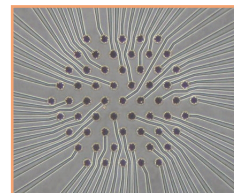
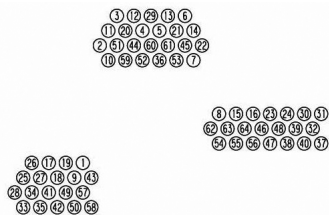
HIPPOCAMPAL PATTERN ARRAYS (CA1, CA3, DG) / HEXAGONAL ARRAYS (61 ELECTRODES) / 32x 2 / 16 x 4

Product Number	Arrangement	Recording Electrodes		Reference Electrodes		Distance for Electrodes Block	Chamber Depth
		Size	Spacing	Type	Spacing (d)		
MED-P50015	Rat Hippocampus	ϕ 50 μ m	150 μ m	C	10 mm	-	5 mm
MED-P5001A	Rat Hippocampus	ϕ 50 μ m	150 μ m	C	10 mm	-	10 mm
MED-P50025	Mouse Hippocampus	ϕ 50 μ m	150 μ m	C	10 mm	-	5 mm
MED-P5002A	Mouse Hippocampus	ϕ 50 μ m	150 μ m	C	10 mm	-	10 mm
MED-P2H075	Hexagonal	ϕ 20 μ m	70 μ m	C	10 mm	-	5 mm
MED-P2H07A	Hexagonal	ϕ 20 μ m	70 μ m	C	10 mm	-	10 mm
MED-P50035	32(4x8) x 2	ϕ 50 μ m	150 μ m	D	10 mm	11.75 mm	5 mm
MED-P5003A	32(4x8) x 2	ϕ 50 μ m	150 μ m	D	10 mm	11.75 mm	10 mm
MED-P50045	16(4x4) x 4	50 x 50 μ m	150 μ m	B	12 mm	5.5 mm	5 mm
MED-P5004A	16(4x4) x 4	50 x 50 μ m	150 μ m	B	12 mm	5.5 mm	10 mm



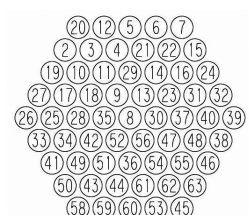
MED-P5001A

Micrograph of rat hippocampal slice and arrangement of microelectrodes



MED-P2H07A

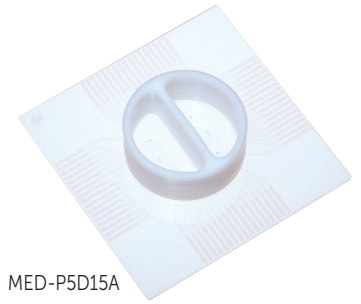
Close up view and arrangement of microelectrodes



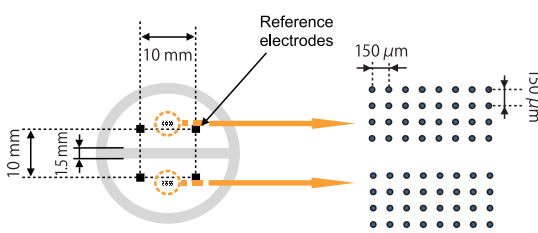
MULTI-SAMPLE PROBES

Product Number	Number of Wells	Number of Electrode /Well	Recording Electrodes		Reference Electrodes		Chamber Depth
			Size	Spacing	Type	Spacing (d)	
MED-P5D15A	2	32 (4x8)	ø50 µm	150 µm	D (2)	10 mm	10 mm
MED-P5D15B	2	32 (4x8)	ø50 µm	150 µm	D (2)	10 mm	10 mm ^(*)
MED-P5DF15	2	32 ((4x4) x 2)	50 x 50 µm	150 µm ^(*)	B (2)	12 mm	10 mm
MED-P5FF15	4	16 (4x4)	50 x 50 µm	150 µm	B (1)	12 mm	10 mm

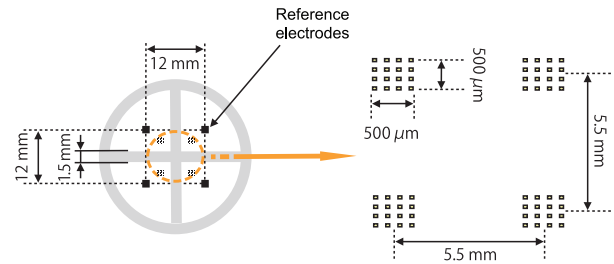
^(*)Partition height : 5 mm, ^(*)Electrode block distance: 5.5 mm



MED-P5D15A



Electrode arrangement for MED-P5D15A, MED-P5D15B, and MED-P50035/A (with no partition)



Electrode arrangement for MED-P5FF15, MED-P5DF15 (with one partition), and MED-P50045/A (with no partition)

MED PROBES 16 (FOR MED64-QUAD II)

Product Number	Number of Electrodes	Arrangement	Array Size	Recording Electrodes		Reference Electrodes		Chamber Depth
				Size	Spacing	Type	Spacing (d)	
MED-PG515A	16	4x4	0.5 x 0.5 mm	50 µm	150 µm	E	14 mm	10 mm
MED-PG5001A	16	2x8	0.5 x 0.5 mm	50 µm	150 µm	E	14 mm	10 mm



MED-PG515A

MED MULTI-WELL PROBES (FOR MED64-ALLEGRO)



MED-P5NF30

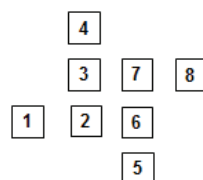


MED-P5N811

Electrode arrangement in a well



MED-P5NF30



MED-P5N811

Product Number	Wells				Recording Electrodes			Reference Electrodes	
	Number	Diameter	Depth	Distance	Number / well	Size	Spacing	Type	Spacing (d)
MEE-P5NF30	4	ø16 mm	10 mm	18 mm	16	50 x 50 µm	300 µm	E	12 mm
MED-P5N811	8	7.5 x 16 mm	10 mm	9 mm	8	50 x 50 µm	300 µm	E	5.5 mm

MED64 Mobius

Software that is: Highly-sophisticated, User friendly, Hands-on

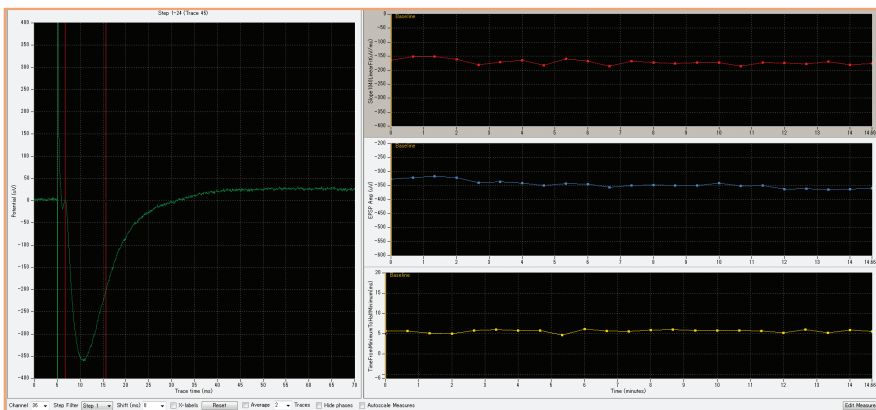
MED64 Mobius is the data acquisition and analysis software for all MED64 Systems. It is designed to be easy for beginners and powerful enough for advanced users. Mobius comes in various application-specific packages including "Evoked Potential Measurement", "Spike Sorter", "QT", as well as combined packages for multi-application users.

It features a broad set of analysis tools including spike frequency and waveform analysis. All analyses are performed at all acquisition channels both during acquisition as well as post acquisition.

EVOKED POTENTIAL MEASUREMENT PACKAGE [MED-MS64MR11]

For recording and analysis of fEPSPs / LTP / LTD

- Extractions of evoked local field potentials (e.g. fEPSPs).
- A broad set of waveform analyses (e.g. amplitude, slope, area, time).
- Cumulative plots for the analysis during and post acquisition.
- Easy-to-set acquisition and stimulation parameters.
- Capability to design and apply complex stimulation sequences (e.g. theta burst).
- Export raw data in binary or ASCII text file (csv).
- Export extracted waveforms and all analysis results as ASCII text files.

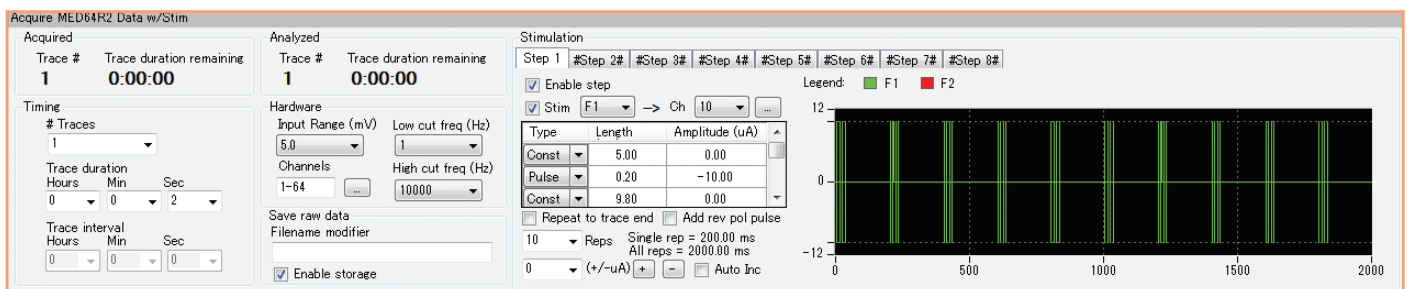


fEPSPs analysis

[Left] extracted evoked signal (fEPSP). [Right] Time course of analyzed 1) Amplitude Minimum (red), Slope 10-40% (blue), and 3) Time from minimum to half minimum (yellow).

Examples for the waveform analysis

- Amplitude (Minimum, Maximum, Peak to Peak)
- Slope (10-40%, 10-90%, Linear fit)
- Absolute Area
- Pop Spike Area
- Time of Amplitude Minimum (Maximum)
- Time from Minimum/Maximum to Half Minimum/Maximum
- Paired-pulse Ratio for above protocols
- And More

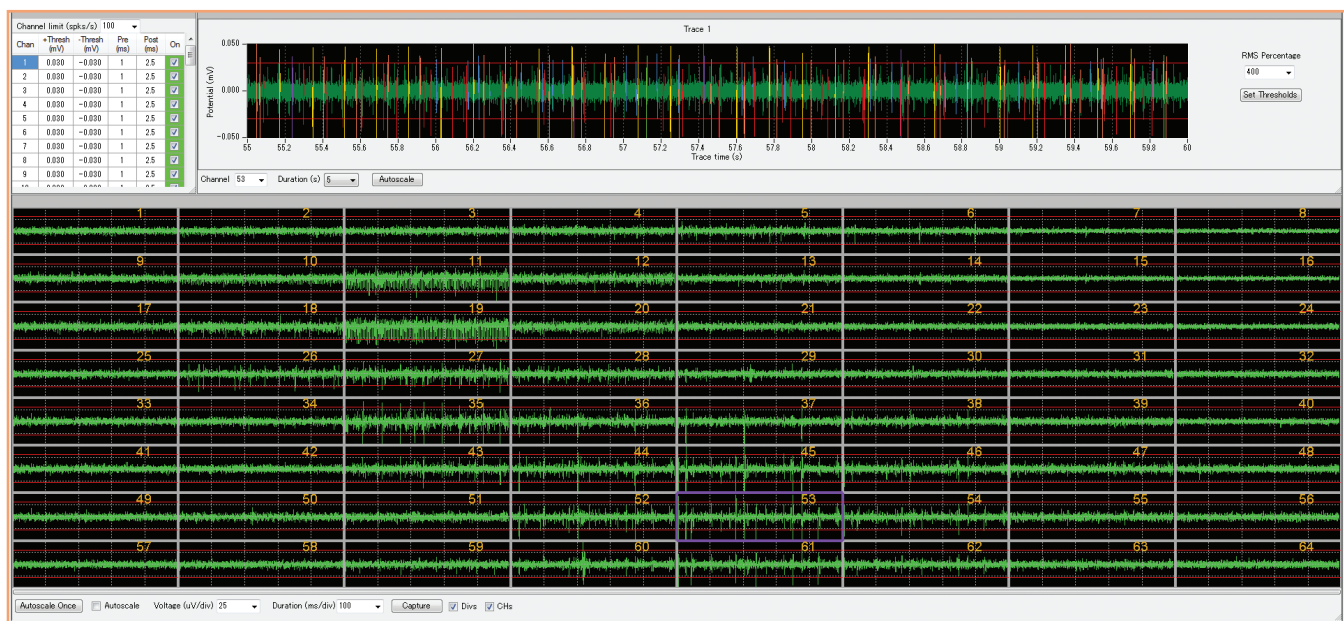


Control panel for acquisition/stimulation parameters.

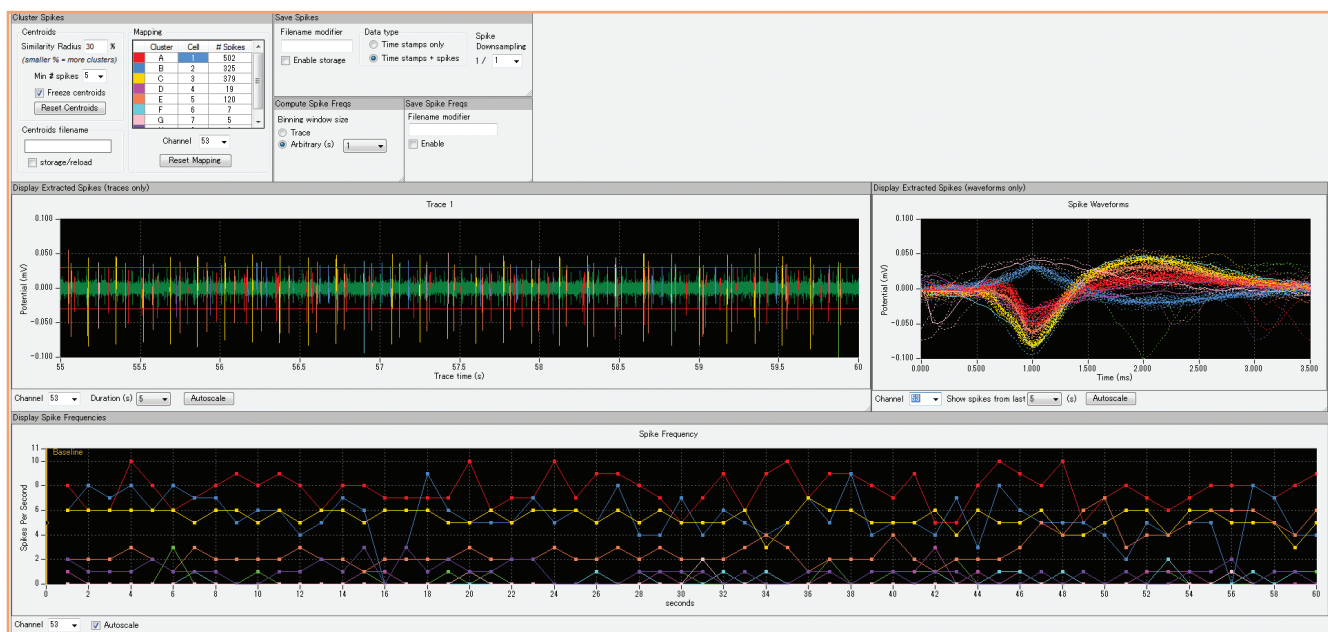
SPIKE SORTER [MED-MS64MR12]

For recording and analysis of neuronal spikes

- Extractions of spikes exceeding user-defined thresholds.
- Set thresholds by either 1) moving bars at the all channels (or single channel) display, 2) typing numbers in the chart, or 3) a percentage of the RMS noise.
- Spike sorting based on waveform similarities.
- Spike frequency analysis at all channels and build of their cumulative plots.
- Easy-to-set acquisition parameters.
- Export raw data as binary or ASCII text file (csv).
- Export 1) extracted spikes' waveforms, 2) time stamps for extracted spikes, 3) spike frequency chart as ASCII text files (csv).



Spike extraction.



Spike sorting and frequency analysis for sorted spikes.

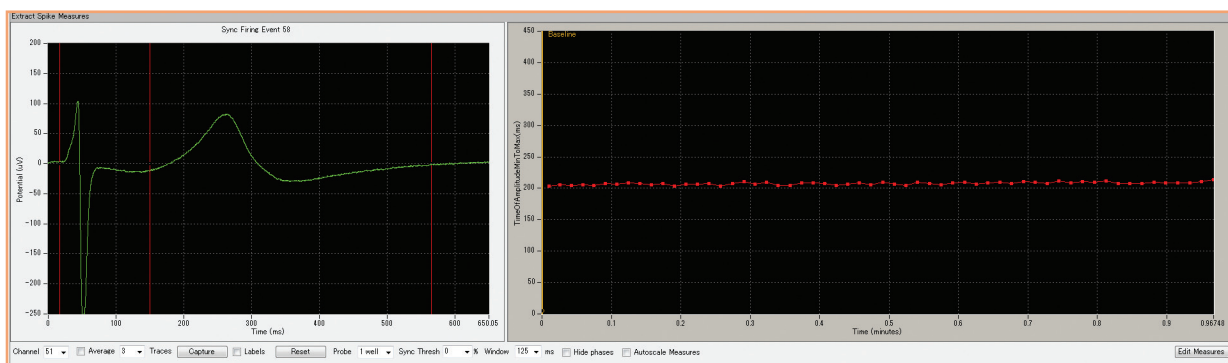
MOBIUS QT [MED-MS64MR21]

For recording and analysis of myocardial signals / Field Potential Duration analysis

- Extractions of myocardial signals exceeding user-defined thresholds.
- Beat frequency analysis (with computation and graphs).
- Inter-spike intervals analysis (with computation and graphs).
- Various waveform analysis tools (amplitude, slope, duration, etc) for extracted signals and cumulative plots for the analysis.
- Field Potential Duration analysis via several different methods.
- Export raw data as binary or ASCII text file (csv).
- Export extracted signals and all analysis results as ASCII text files (csv).



Extractions of myocardial signals (bottom), analysis for beat frequency (top) and inter-spike interval (middle).



Field Potential Duration analysis by measuring peak-to-peak duration.

EXAMPLES OF MOBIUS PACKAGES

Package	Parts Number	Acquisition	Stimulation	Waveform Analysis	Spike Extraction	Spike Frequency Analysis	Spike Sorting	Inter-spike intervals
EP (Evoked Potential)	MED-MS64MR11	O	O	O	X	X	X	X
Spike Sorter	MED-MS64MR12	O	X	X	O	O	O	X
Spike Sorter with Stim	MED-MS64MR13	O	O	X	O	O	O	X
QT	MED-MS64MR21	O	X	O	O	O	X	O
QT with Stim	MED-MS64MR22	O	O	O	O	O	X	O
Mobius Pro	MED-MS64MR14	O	O	O	O	O	O	X
Mobius Extended	MED-MS64MR02	O	O	O	O	O	O	O

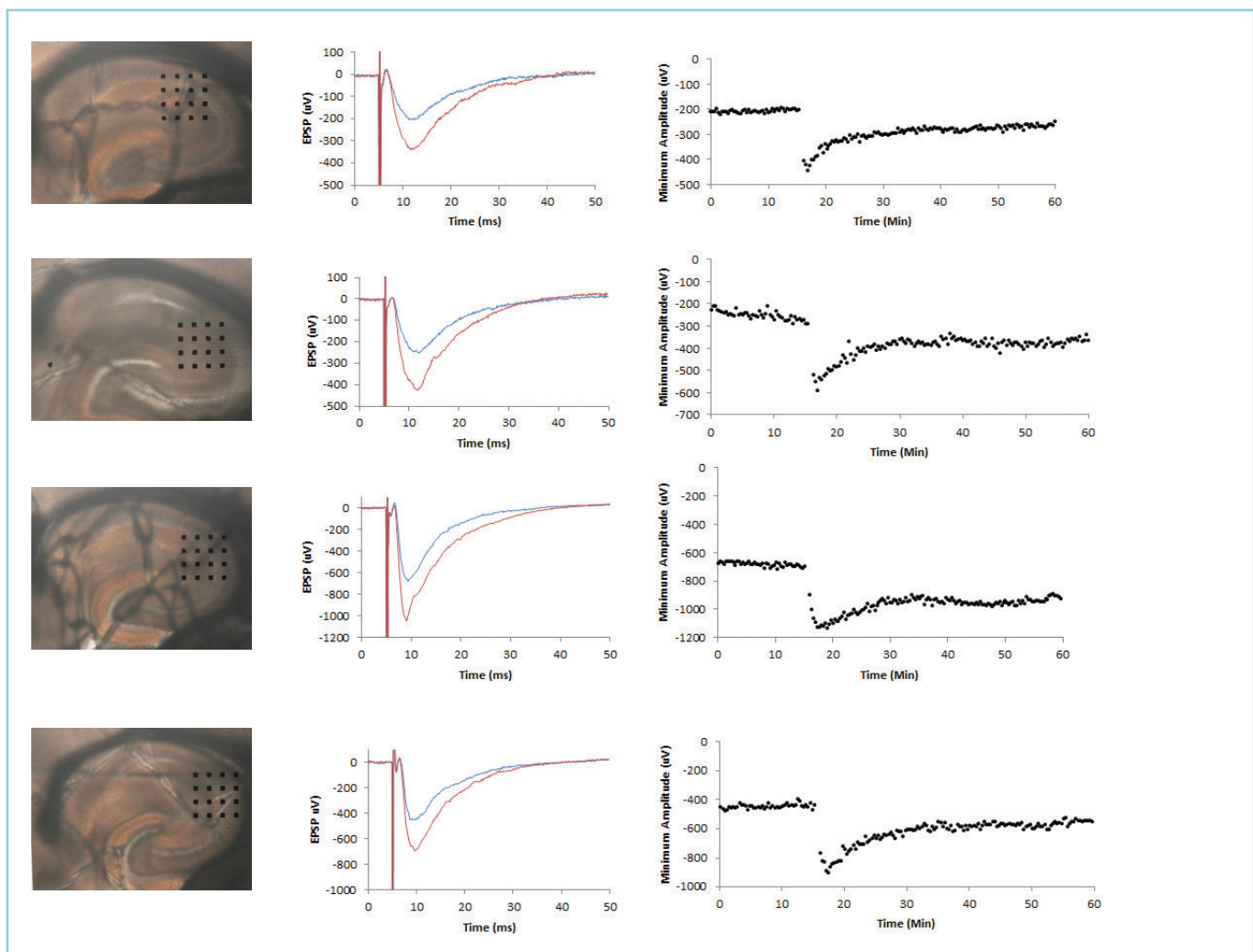
MED64 Systems are widely used in studies of the central and peripheral nervous system as well as myocardial and other muscle preparations. Hundreds of publications provide evidence of the variety of applications. The MED64 is well-suited for experiments on acute tissue preparations or cultures and provides a powerful solution for drug testing due to its easy-to-use interface and reliable data reproducibility.

Applications

- Brain slice evoked activity (fEPSP)
- Synaptic plasticity, learning and memory (LTP/LTD)
- Spontaneous activity (Spikes)
- Rhythmic activity and oscillation
- Network activity
- Evaluation of cardiomyocyte field potential duration (FPD)
- Stem cell research
- Drug discovery using acute tissue preparations
- Neurological and cardiac disease models (epilepsy, Alzheimer's, pain, feeding behavior, arrhythmias, etc.)
- Neurotoxicity screening
- Chronic drug testing with cultures
- And more

LTP ASSAY FROM 4 MOUSE HIPPOCAMPAL SLICES

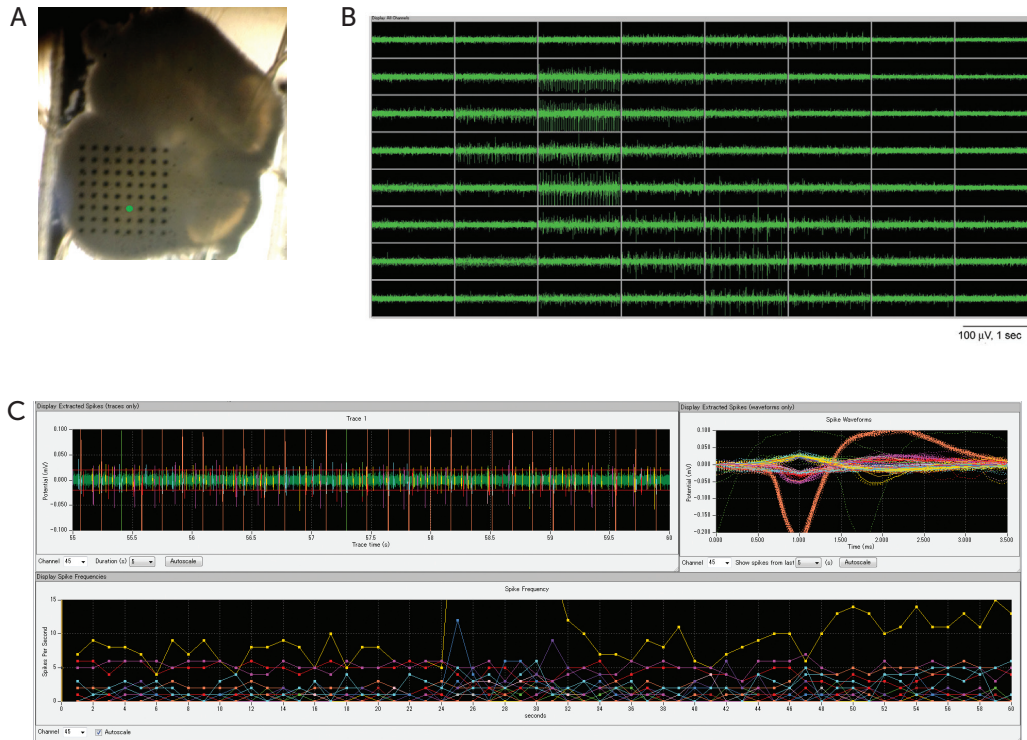
Hundreds of scientific publications provide evidence the MED64 is particularly well-suited for acute slice recording. Its low-impedance/high capacitance electrodes provide high-quality evoked signals without interference of stimulus artifacts. The MED64 is a powerful solution for drug discovery using acute brain slices by increasing your throughput in number of slices processed with high data reproducibility.



Data obtained from a LTP assay using the MED64-Quad II. Left shows hippocampal slices obtained from 1 mouse brain. Middle panel shows evoked EPSP traces before (blue trace) and after (red trace) theta burst stimulation. The right panel shows data obtained from each slice.

The MED64's unrivaled signal-to-noise ratio resolves even small single-unit activities that can be hidden in the noise of other systems. The clean spike recordings enable advanced studies and/or extensive discovery in toxicity studies. It is the only MEA system which is compatible with recording in a humidified incubator and is an ideal solution for long-term evaluation of cell growth or chronic drug effects.

SINGLE UNIT ACTIVITIES FROM SPINAL CORD SLICES

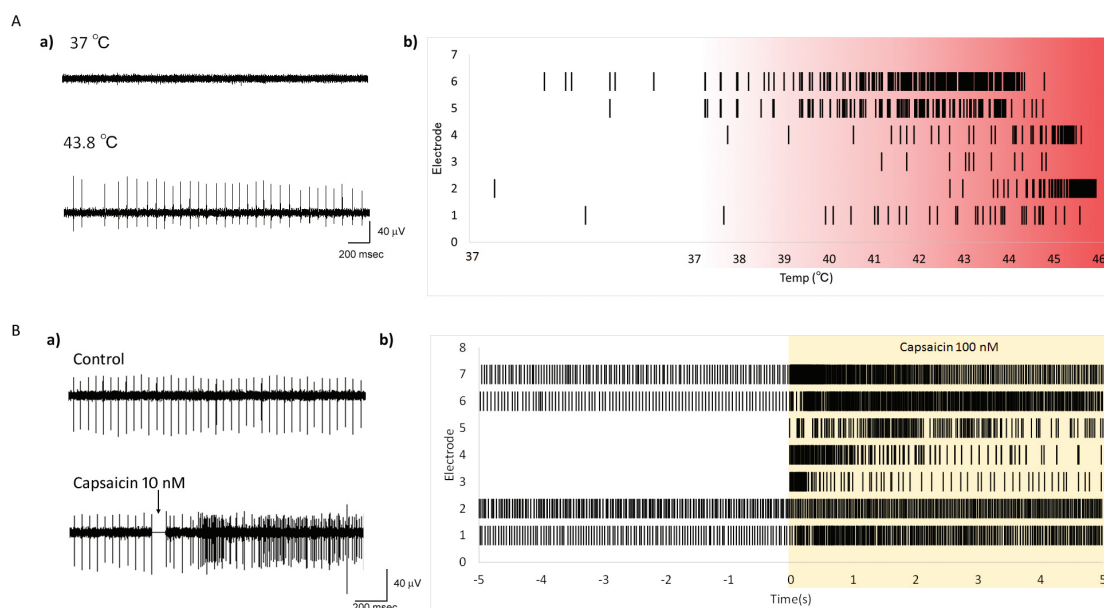


[A] Micrograph of a mouse spinal cord slice placed on MED Probe.

[B] Spontaneous activities were recorded at many channels.

[C] Analysis for channel 45 (marked with green in the top-left photo) performed by Mobius software. Spikes (single unit activities) are extracted via a user-defined thresholds ($\pm 20 \mu V$). Spikes are sorted and clustered based on waveform similarity (right). Spike frequency is displayed for extracted single units spikes based on a sophisticated spike sorting algorithm.

CHANGES IN DRG NEURAL ACTIVITY INDUCED BY HIGH TEMPERATURE OR CAPSAICIN

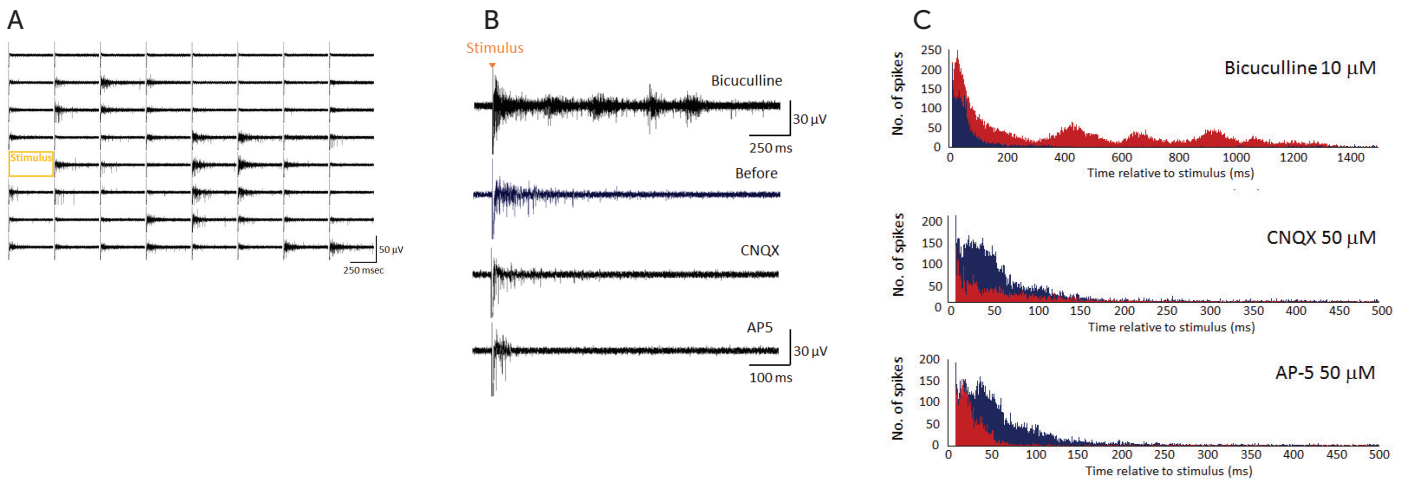


Rat DRG neurons are cultured on a MED Probe (4 days in culture) and changes of spontaneous firings with temperature variation and administration of Capsaicin is observed. [A] a: Spontaneous firing recorded from 1 electrode at 37°C and 43.8°C. b: Raster plots for distribution of extracted spikes across multiple selected electrodes. Spike frequencies increase as temperature rises.

[B] a: Spontaneous firing recorded from 1 electrode before and after administration of Capsaicin (100 nM). b: Raster plots for distribution of extracted spikes across multiple selected electrodes. Capsaicin increases firing rate remarkably.

Courtesy of Dr. Ikuro Suzuki, Tohoku Institute of Technology.

PHARMACOLOGY STUDIES ON EVOKED POTENTIALS FROM iPSC-DERIVED NEURONS



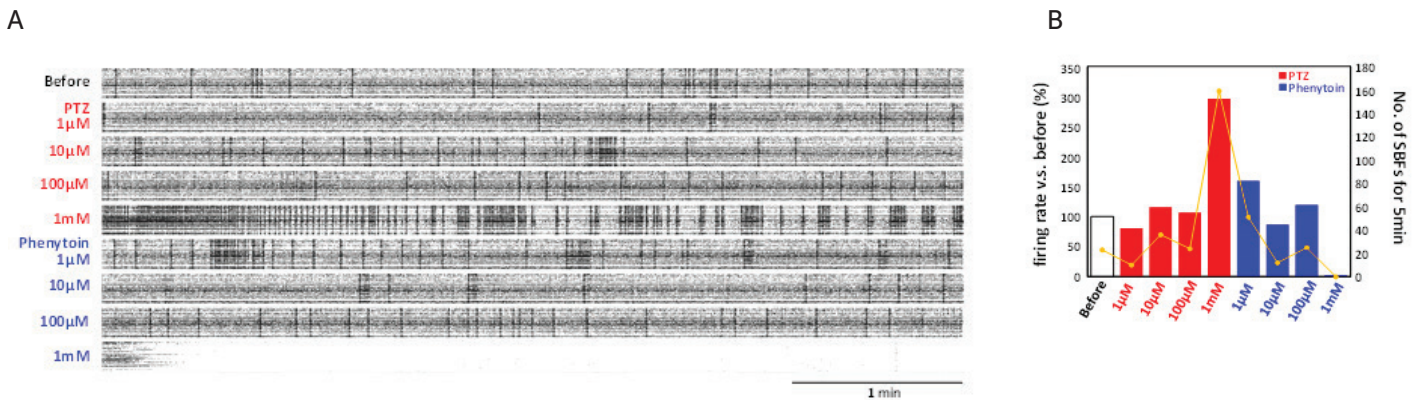
Human iPSC-derived neurons were co-cultured with astrocytes on MED Probes for 33-36 weeks. Effects of multiple antagonists were examined on evoked responses.

[A] Representative evoked responses recorded at 64 electrodes following electrical stimulus to one electrode (indicated with orange).

[B] Typical evoked responses recorded at 1 electrode before and after drug administration. Orange triangle shows stimulus timing.

[C] Time histogram for number of spikes recorded at 63 electrodes (after 10 individual stimulus, bin size=1ms). Blue and red indicate before and after drug administrations respectively. Administration of bicuculline increases both number of spikes and burst duration. CNQX significantly decreases number of spikes but not burst duration. AP-5 decreases both number of spikes and burst duration, but these decreases are modest compared with CNQX.

EVALUATION OF ANTI-EPILEPSY DRUG EFFECTS ON iPSC-DERIVED NEURONS



Induction and suppression of epileptiform activities are examined using the MED64.

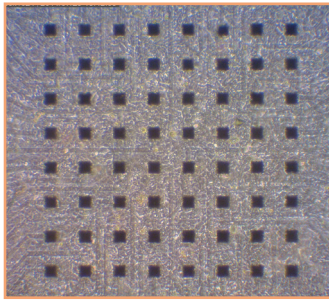
[A] Pentylenetetrazole (PTZ) and then phenytoin (an anti-epilepsy drug) is administrated to iPSC-derived neuron cultured on the MED Probe (20 weeks in culture) with cumulative concentrations. Spontaneous firings are recorded from all 64 electrodes, and the distribution of extracted spikes across 64 electrodes are displayed in raster plots (appearance of black vertical lines indicates synchronized bursts (SB)).

[B] Summary for the change of spike rate (with red bar for PTZ while blue bar for phenytoin) and number of synchronized burst frequencies (SBFs) for 5 minutes. PTZ induce rapid increase both for spikes and SB, that is suppressed with phenytoin.

Courtesy of Dr. Ikuro Suzuki, Tohoku Institute of Technology. Further information is in *Physiological maturation and drug responses of human induced pluripotent stem cell-derived cortical neuronal networks in long-term culture*. Odawara At et al, *Sci Rep*. 2016 May 18;6:26181.

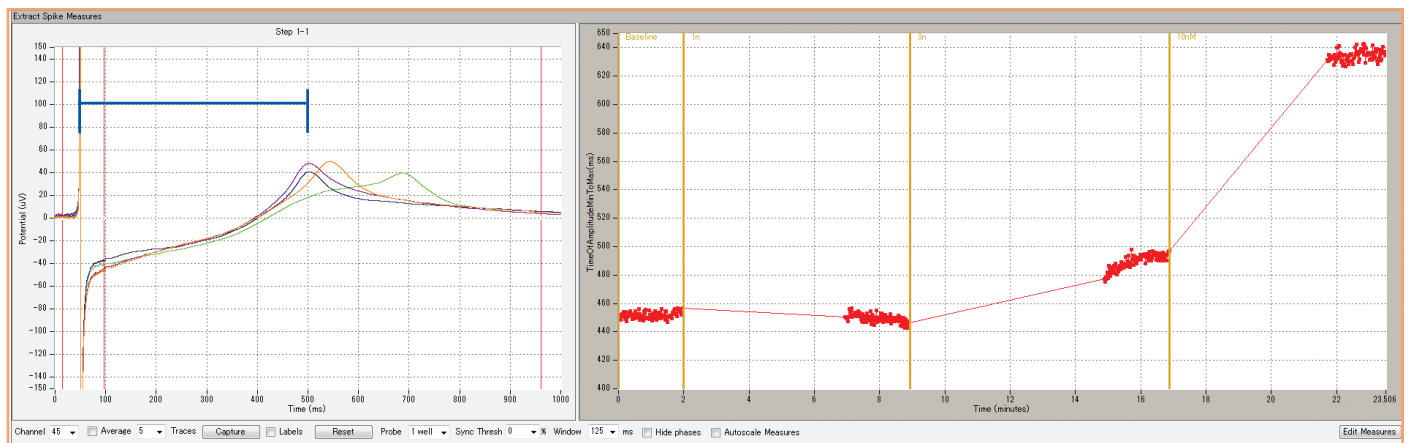
MED64 Systems are well suited for cardiac studies such as safety screening as well as observation of signal propagation and conduction velocities. With the industry's highest-sensitivity electrodes, the MED64 provides clean signals for each recording (without averaging), enabling advanced screening. Its high-capacitance electrodes allow delivery of stimulus current as high as 200 μA through any of the 64 electrodes, enabling propagation analysis of paced activity as well as spontaneous activity measurements.

EVALUATION OF DRUG DEPENDENT PROLONGATION OF FIELD POTENTIAL DURATION WITH iPSC-DERIVED CARDIOMYOCYTES

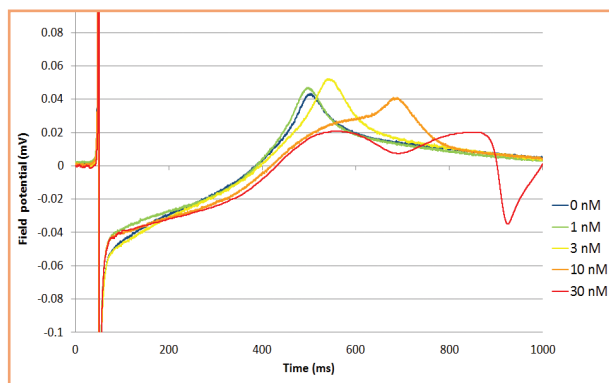


[Top] Human iPSC-derived cardiomyocytes plated and cultured on a MED Probe.

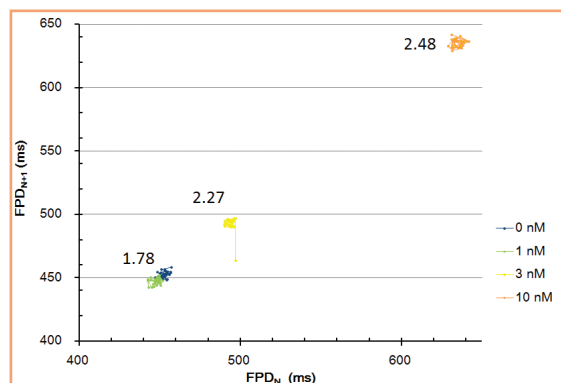
[Bottom] Field Potential Duration (FPD) analyzed with Mobius during acquisition. The left chart shows acquired signals. The right graph shows time course for waveform analysis. The duration from the first peak to the second peak (indicated with blue bar) is automatically measured and graphed. The administration of E4031 prolonged FPD in a dose-dependent manner.



E4031



STV_{FPD}



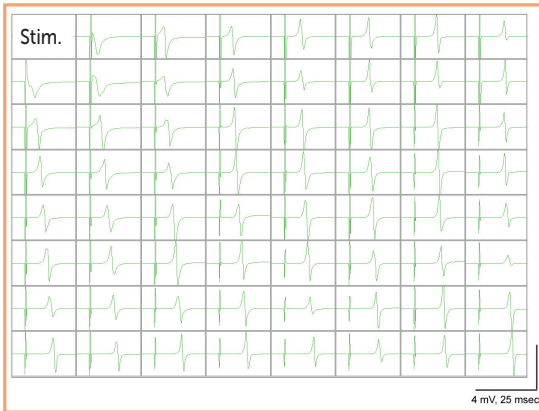
[Left] Overlays of waveforms for each dose. Administration of E4031 prolonged FPD in dose-dependent manner at 3-10 nM and elicited Early After Depolarization (EAD) at 30 nM.

[Right] Poincare plot for Short Term Variability (beat-to-beat variability) of the field potential duration (STV_{FPD}). Administration of E4031 increases the STV_{FPD} in dose-dependent manner as well.

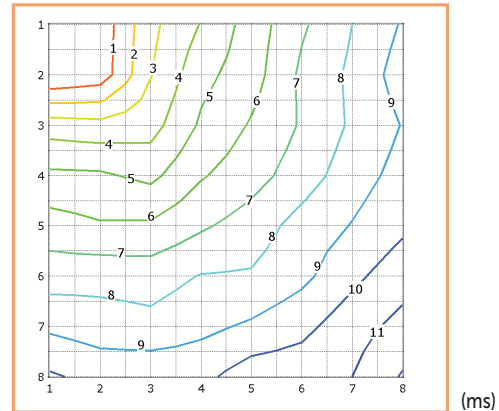
PROPAGATION

APPLICATIONS

SIGNAL PROPAGATION FOR PACED ACTIVITY



[Left] Signals recorded from human iPSC-derived cardiomyocytes. Channel 1 was paced and signals were acquired from the remaining 63.



[Right] Phase map for distribution of depolarizing spikes (first peak after stimulus artifacts).

COMPATIBILITY

Products	Parts Number	MED64-Basic	MED64-Quad II	MED64-Allegro	MED64-Plex 4/8
Main Amplifier	MED-A64MD1	○	○	○	○
Head Amplifier	MED-A64HE1S	○	○	○	○
Connector	MED-C03	○			○
	MED-CP04	○			○
	MED-C04		○		
	MED-C05		○		
	MED-C11			○	
MED Probe	MED-P2105/A	○			○
	MED-P5155/A	○			○
	MED-P5305/A	○			○
	MED-P5455/A	○			○
	MED-P50015/A	○			○
	MED-P50025/A	○			○
	MED-P2H075/A	○			○
	MED-P50035/A	○			○
	MED-P50045/A	○			○
	MED-P5D15A	○			○
	MED-P5D15B	○			○
	MED-P5DF15	○			○
	MED-P5FF15	○			○
	MED-PG515A		○		
	MED-PG5001A		○		
	MED-P5NF30			○	
	MED-P5N811			○	
Perfusion Accessory	MED-KCAP01(TU)	○	○		○
	MED-KPK02(TU)	○			○
ThermoBase	MED-CPB01		○	○	
Connector Cover	MED-CC06	○			○
	MED-CC02		○		
	MED-CC03			○	

SPECIFICATIONS

MED64 Amplifiers

MED64 Main Amplifier [MED-A64MD1]

Amplifier		Digitizer	
Number of channels	64	Resolution	16 bit
Gain	x 20-217	Sampling rate	20 kHz/channel
Bandwidth	0.1Hz - 10 kHz	Output	USB
Analog low-cut filter	0.1, 1, 10, 100 Hz	General	
Analog high-cut filter	1.0, 2.0, 2.5, 5.0, 7.5, 10 kHz	Power supply	AC 100-240V (50-60 Hz)
Input impedance	100 MΩ	Weight (without AC adaptor)	5.9 Kg
		Dimensions (without AC adaptor)	W437 x D430 x H74 (mm)

MED64 Head Amplifier [MED-A64HE1S]

Amplifier		Stimulator	
Number of channels	64	Number of channels	2
Gain	x 10	Output format	Current-driven
Bandwidth	0.1Hz - 100 kHz	Maximum input voltage	+/-4 V
Input impedance	100 MΩ	Maximum output current	+/-200 μA
Output impedance	10 kΩ		
RMS noise (Typical)		General	
*Input short-circuited	14 nV / √Hz	Power supply	AC 100-240V (50-60 Hz)
*MED-P515A input		Weight (without AC adaptor)	6.6 Kg
f < 3 kHz	0.8 μV	Dimensions (without AC adaptor)	W437 x D430 x H74 (mm)
f < 5 kHz	1.2 μV		
f < 10 kHz	1.8 μV		

MED Connectors

MED Connector [MED-C03]

MED Probe securing mechanism	Screw down
Material	Aluminum, Gold plate for contact pins
Contact resistance	<30 mΩ
Printed circuit board	4 layers (The 1st, 4th : ground / 2nd, 3rd: signal line)
Weight	480 g
Dimensions	W174 x D150 x H21 (mm)

MED Mini Connector [MED-C04]

MED Duet Connector [MED-C05]

MED Probe securing mechanism	Slide in
Material	Aluminum, Gold plate for contact pins
Weight	190 g (MED-C04), 385 g (MED-C05)
Dimensions	MED-C04: W60 x D83 x H24 (mm) MED-C05: W130 x D80 x H30 (mm)

MED Multi-well Connector [MED-C11]

MED Probe securing mechanism	Slide in
Material	Aluminum, Gold plate for contact pins
Weight	700 g
Dimensions	W210 x D83 x H34 (mm)

MED ThermoConnector [MED-CP04]

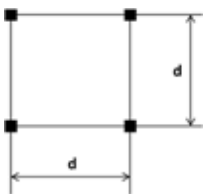
Connector unit	
MED Probe securing mechanism	Screw down
Material	Aluminum, Gold plate for contact pins
Contact resistance	<30 mΩ
Printed circuit board	4 layers (The 1st, 4th : ground, / 2nd, 3rd : signal line)
Heating device	Transistors (2)
Sensor device	Centigrade temperature sensor IC
Temperature accuracy	< +/- 1°C (for solution in the MED Probe)
Range of verified <1°C accuracy	32°C - 37°C (RT=25°C)
Weight	510 g
Dimensions	W200 x D105 x H20 (mm)
Temperature controller	
Temperature control unit	OMRON E5GC
Controlling method	Auto-tuning PID temperature control
Resolution	0.1°C
Power supply voltage	DC ±12V
Consumption current	+1A, -0.1A (typ.) / +2A (max.)
Weight	350 g
Dimensions	W150 x D110 x H50 (mm)
Power supply unit, Input	AC 100-240 V (50-60 Hz)
Power supply unit, Output	DC ±12V

MED Probes

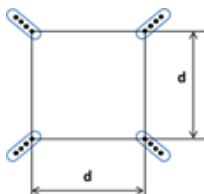
Substrate/Chamber		Recording Electrodes		Reference Electrodes			
Substrate	Glass, T = 0.7 mm	Material	Platinum black	Material	Platinum black		
Conducting layer	Indium tin oxide (ITO), 0.15 μm	Impedance \square 50 μm , ϕ 50 μm 10 k Ω (Typ.) \square 20 μm , ϕ 20 μm 15 k Ω (Typ.) (1 kHz, 50 mV applied sinusoidal wave)		Type	Size	Number of electrodes/ chamber (well)	Total impedance/ chamber (well) (f=1 kHz)
Insulation layer	Acrylic resin						
Cylindrical chamber	Glass (OD:25 / ID:22 mm)			A	100 μm	4	Typ. 550 Ω
	Acrylic resin (for Multi-well Probe)			B	200 μm	4	Typ. 550 Ω
Substrate size		Maximum stimulus output		B (1)	200 μm	1	Typ. 2.2 k Ω
MED Probes (all types)	50 x 50 mm	Current-driven	$\pm 200 \mu\text{A}$ (t=300 μs)	B (2)	200 μm	2	Typ. 1.1 k Ω
MED Probe 16	30 x 40 mm	Voltage-driven	$\pm 1 \text{ V}$	C	ϕ 100 μm	16	Typ. 550 Ω
MED Multi-well Probe	100 x 35 mm			D	ϕ 100 μm	16	Typ. 550 Ω
				D (2)	ϕ 100 μm	8	Typ. 1.1 k Ω
				E	200 μm	16	Typ. 300 Ω

TYPE FOR REFERENCE ELECTRODES

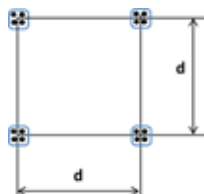
A,B:



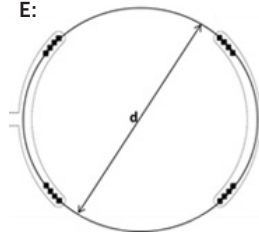
C:



D:



E:



Accessories

MED64 ThermoBase [MED-CPB01]

Material	Aluminum
Heating device	Transistor
Temperature accuracy	< +/- 1°C (for solution in the MED Probe)
Range of verified < +/- 1 °C accuracy	With perfusion : < 32 °C (RT=25°C)
	Without perfusion : <37 °C (RT=25°C)
Dimensions	W160 x D110 x H17 (mm)
Weight	370 g

MED Connector Cover [MED-CC06/02/03]

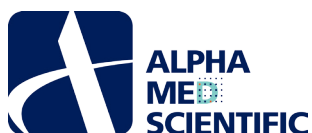
Material	Acrylic board
Dimensions (mm)	MED-CC06: W215 x D120 x H95
	MED-CC02: W220 x D175 x H90
	MED-CC03: W235 x D130 x H130
Weight	MED-CC06: 442 g
	MED-CC02: 588 g
	MED-CC03: 601 g
Ports	1 on the top
	2 on the side (for cables)

MED64 Multiplexer

	[MED-A64SF1]	[MED-A64SF2]
Number of channels per input	64	64
Number of Inputs	4	4
Number of input (bypassing MUX)	None	1
Gain	x 1	x 1
Maximum input / output voltage	+/- 4 V	+/- 4 V
Control signal	3 bit BCD	3 bit BCD
Control signal level	TTL	TTL
Power supply	AC 100-240V (50-60 Hz)	AC 100-240V (50-60 Hz)
Weight (without AC adaptor)	6.1 Kg	6.2 Kg
Dimensions (witholut AC adaptor)	W430 x D437 x H74 (mm)	W430 x D437 x H74 (mm)

MED64 product information

www.med64.com



Alpha MED Scientific Inc.

Saito Bio-incubator 209
7-7-15, Saito-asagi, Ibaraki,
Osaka 567-0085, Japan

Phone: +81-72-648-7973

FAX: +81-72-648-7974

E-mail: info@med64.com

Manufactured by Alpha MED Scientific Inc.

Patents (owned by Panasonic)

U.S.: RE38323: RE37977: 5,810,725: 6,151,519: 6,297,025: 6,511,817: 6,890,762: CA: 2316213

Europe: EP0689051B1

Japan: 2949845: 3101122: 3193471: 32204875: 3577459: 361972

Korea: 150390: 291052: 4933913

Taiwan: 128335: 243483

CN: 988133156.6

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Ask us about your specific application.

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