



Neuropack X1

# Excellence in EMG/EP diagnostics

The Neuropack X1 measurement system is the latest and most advanced EP/EMG system in the Nihon Kohden product portfolio. Available with either a six- or twelve-channel amplifier and up to two electrical stimulators, the Neuropack X1 is designed with numerous time-saving features to maximize the user's workflow without compromising the integrity of data acquisition. Basic exam software including EMG, NCS, and SEP protocols come standard with the Neuropack X1 measurement system. The new examination list creates a seamless integration of protocols, patients, and reports, thus increasing productivity and reducing test time.

The mobile functional keypad enables the user to complete an entire exam without the use of a keyboard or mouse. This simple control panel contains the main operation buttons seen in previous models, with added key features such as functional keys and a numeric pad. The Neuropack X1 measurement system is built to cover all aspects of diagnostics, delivering innovative functionality, high signal quality, and durability to ensure efficiency – all while remaining simple to use.



# Neuropack X1

## User-friendly control panel

The simple and easy-to-use control panel allows smooth examination. The big main operation buttons of the Neuropack series have been proven in many previous product generations. This concept has been further enhanced by providing many dedicated buttons so that there is no more need to use your computer's keyboard or mouse during an examination.

## Low-noise amplifier and active electrodes

The low-noise amplifiers and the active electrodes that reduce stimulus artifacts speed up the examination by providing clean waveforms easily and quickly. The integrated impedance check, which can be activated directly via the input box, ensures reliable placement of electrodes. The anatomically placed input jacks allow for easy and comfortable electrode connections.

## Multitasking window

Up to eight test protocol windows can be open simultaneously, thus making it easy to revisit previous steps of the examination series. The examination list is your central navigation portal during and after the examination and allows you to easily track what has been done already.

## Reporting

NeuroReport is the common reporting tool for all EEG, EMG, and IOM systems by Nihon Kohden. Various pre-defined templates can be used to create customized reports for different examination types. A powerful auto-text function helps to create individual reports. The reports that are saved within the database in a license-free format will automatically be converted to PDF after finalizing. This prevents those important medical documents from being tampered with and makes them available in a universal software format as well.

## NeuroNavi

The NeuroNavi on-screen examination guide shows examination information, electrode, and stimulation positions for NCS and other examinations. By including technical and physiological background information, the NeuroNavi goes way above the typical obligatory operation manual. On-screen operation manuals are also available. You can refer to the NeuroNavi and operation manuals at anytime.

## Standard examination programs

### Electromyography

The routine EMG program utilizes auto MUP detection and classification and real time turns/amp analysis. A functional and sophisticated findings screen meets various needs in clinical use thanks to its easy and smooth operation.

**Quick display:** You can easily switch between four measurement modes that you can define freely - for example for insertion activity, motor unit detection, or turn / amplitude analysis, or interference - by pressing a button at the bottom of the screen or on the control panel.

**MUP:** MUP waveforms are automatically detected and classified into groups of similar shaped MUPs. MUP measurement result (duration, amplitude, phase, turns, and firing rate) are shown next to the waveforms or on a dedicated summary screen. The averaged MUP of the same MUP groups are calculated and displayed with the numeric data.

**Trigger EMG:** A cascading waveforms window displays the waveform that are triggered by either level trigger, window trigger, or rise time trigger in chronological order. You can change the duration (beginning and ending point of MUP). Up to new eight sequential MUP waveforms are displayed on the MUP sweep window without scrolling. You can easily select the waveforms just by the use of a button.

**Interference:** Turns/amp measurement is automatically performed. The measurement result at every one second is displayed on the turns-interval histogram, turns/amp histogram, and turns/amp graph. The turns/amp normative data of several muscles is installed as default settings and its normative area is displayed in the turns/amp histogram. You can easily recognize whether or not the measuring waveforms are in the normative range.

**Muscle summary:** The summary window (muscles) is the best place to start typing the EMG findings – right next to the results of the examination. The latest EMG findings screen shows up to 26 traces of waveforms with annotations in the MONITOR waves window and up to 20 MUP waveforms in the MUP window on one screen for efficient and quick EMG evaluation.

**EMG playback software:** You can also easily review any acquired waveform with sound after measurement by clicking the EMG player button. This tool also lets you play back EMG files with sound on a review stations for presentations and lectures.

**Quantitative EMG (QEMG):** Real-time MUAP analysis: With the template matching method, MUAP are automatically classified into several patterns and the amplitude, phase, turns, area, rise time, and firing rate are quantitatively analyzed in real-time.

### Neurography

**Nerve conduction study (NCS):** The NCS program lets you perform MCS, SCS, and F-wave in one program.

#### Motor NCS/sensory NCS:

- When measuring with the MEB there is no need to manually pick the stimulation site before starting the recording. The software does this automatically for you and, if necessary, it can be easily changed.
- Side comparisons and combined motor and sensory tests can be shown on one waveform screen and also have their own dedicated evaluation tables.
- Normative data is shown on the same screen.
- The superimposed waveform is shown in real time at the same time, so that you can easily compare the amplitudes of all stimulation sites and thus judge the quality of your stimulation.

#### Repetitive stimulation:

- The amplitude of each sequence is displayed as a bar graph on the same screen. You can see the summary of the repetitive stimulation study at a glance. The waveform of each sequence can be displayed by clicking the corresponding bar graph.
- Up to twelve sequences of stimulation patterns can be set for one automatic measurement (automatic sequence function).
- Stimulation can be done with either high or low frequency or combined in the same protocol.

**F-wave:** With the dual-sensitivity function, both M- and F-wave are displayed with a proper amplification. F-wave latency is displayed in the F-wave histogram window.

**H-reflex:** The intensity-amplitude graph and superimposed waveforms are displayed on the same window.

**Blink-reflex:** The relation between the mark position and the normative range is easy to see on the blink-measurement table window.

### Somatosensory evoked potentials

Standard SEP examination protocols range from SSEP to ESCP.

**ECG artifact-free SSEP:** With ECG-SSEP protocol, stimulation and averaging is done during the flat period of the ECG waveform so artifact-free waveforms can be recorded.

**Signal triggering and back averaging:** Cortical potentials prior to muscle contraction can be recorded by using a rectified EMG signal trigger and back-averaging.

**Simultaneous SSEP and SEP measurement:** Upper and lower extremity measurements can be conducted at the same time on the same screen.

**Side comparison:** Split screen display allows for side comparisons at one glance.

## Optional examination programs

### Visual evoked potentials

**Variety of visual stimulations:** A monitor for pattern reversal, LED goggles and flash stimulator options allows for complete visual testing.

**EOG velocity waveform display:** With the integrated differential amplifier, the velocity waveform can simultaneously be displayed along with the original EOG signal.

**AEP:** Standard AEP examination protocols are

- ABR (auditory brainstem response)
- MLR (middle latency response)
- SVT (slow vertex response)
- EcochG (electrocochleogram)

**ABR auto marking:** In the ABR protocol, automatic waveform marking allows time saving measurement of latency, amplitude, and interval.

**Automatic separation of AP and CM waveforms:** In EcochG examination, AP and CM can be automatically separated from the original waveforms in real time. The original, AP and CM waveforms are simultaneously displayed on the screen.

**Simultaneous ABR and MLR:** ABR and MLR can be measured simultaneously on the same screen.

### Autonomic nerve system testing

**R-R interval:** For the heart rate variability testing, the rate variations can be evaluated by either FFT or MEM analysis in addition to the classic sequential evaluation.

**SSR:** Sympathetic skin response measures potential change of the skin which is evoked by somatosensory, auditory, or visual stimulation. Up to 9999 evoked waveforms can be temporarily saved in memory.

### Single fibre and macro EMG

Jitter reanalysis is possible at different trigger levels for all acquired waveforms. MCD, MSD, MIPI, firing rate, and blocking can be automatically analyzed. Two single fiber modes are available: voluntary contraction and stimulated.

## Data integration and management

**Polaris.one:** The software allows you to easily manage data and examination schedules.

- SQL based database for EEG, EMG/EP, and ECG data
- User interface can be scaled according to user needs, for example by removing unnecessary buttons or selecting the data to be displayed.
- Calendar view and to-do lists.
- Copies of data can be stored for personal or global use while still being managed by the database.
- Auto-proposing for text input fields.
- Manual, semi-automatic, and automatic transfer and archive as background service.
- Integrated NeuroReport, featuring a multitude of templates for all examinations.
- Offline functionality for acquisition and review stations, making your workflow immune against network communication losses at any time.
- Multi-client-capability with user-related filtering of patients.
- Extensive user rights management (via groups).
- Activity log records all changes to medical data.
- Integrated DVD/CD burning.

# Specifications

## MEB-2300

### Amplifier

<b>Number of channels</b>	JB-206B: 6, / JB-212: 12
<b>Input impedance</b>	200 M $\Omega$ $\pm$ 20% (differential mode), 200 M $\Omega$ $\pm$ 20% (when the active electrode cable is used, differential mode), $\geq$ 1000 M $\Omega$ (common mode)
<b>Noise</b>	< 0.6 $\mu$ Vrms at 1 Hz to 10 kHz, < 1.1 $\mu$ Vrms at 1 Hz to 10 kHz (when the active electrode cable is used)
<b>Common mode rejection ratio</b>	$\geq$ 106 dB (balanced mode), $\geq$ 90 dB (balanced mode, when the active electrode cable is used), $\geq$ 112 dB (isolation mode)
<b>Sensitivity</b>	1, 2, 5, 10, 20, 50, 100, 200, 500 $\mu$ V/ div, 1, 2, 5, 10 mV/div $\pm$ 5%
<b>Low-cut filter</b>	0.01, 0.02, 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 30, 50, 100, 200, 500Hz, 1, 2, 3 kHz ( $\pm$ 20%)
<b>High-cut filter</b>	<i>Channel 1 and 2:</i> 10, 20, 50, 100, 200, 500 Hz, 1, 1.5, 2, 3, 5, 10, 20 kHz ( $\pm$ 20%) <i>Channel 3 to 5:</i> Upper limit 10 kHz at -12 dB/oct ( $\pm$ 20%) <i>Channel 6 to 10:</i> Upper limit 5 kHz at -12 dB/oct ( $\pm$ 20%) <i>Channel 11 and 12:</i> Upper limit 3 kHz at -12 dB/oct ( $\pm$ 20%) <i>AC interference notch filter:</i> 50 or 60 Hz (rejection ratio: < 1/20) <i>Reset:</i> Available <i>Rectification:</i> Off, half, full <i>Electrode impedance check:</i> 2, 5, 10, 20, 50 k $\Omega$ indication <i>Amplitude calibration:</i> 1, 10, 100 $\mu$ V, 1, 10 mV (within $\pm$ 5%)
<b>Acquisition</b>	<i>A/D converter:</i> 18 bits <i>Time-base modes:</i> Individually selected for each channel (up to 12 channels) <i>Monitor time base:</i> 5, 10, 20, 30, 50 ms/ div, 0.1, 0.2, 0.5, 1 s/ div (within $\pm$ 5%) <i>Data points:</i> 2048/20 div <i>Conversion speed:</i> 5 $\mu$ s/1 ch, 10 $\mu$ s/2 ch, 20 $\mu$ s/3 and 4 ch, 50 $\mu$ s/5 to 10 ch, 100 $\mu$ s/11 and 12 ch <i>Analysis time base:</i> 0.1, 0.2, 0.5, 1, 2, 3, 5, 10, 20, 30, 50 ms/ div, 0.1, 0.2, 0.5, 1 s/div (within $\pm$ 5%) or 0.1 to 0.9 ms in 0.1 ms steps (within $\pm$ 5%), 1 to 99 ms in 1.0 ms steps (within $\pm$ 5%) 100 to 1000 ms in 0.01 s steps (within $\pm$ 5%) Delay time: -10 to 10 div in 1 div steps or 0 to 500 ms in 0.1 ms steps <i>Number of averages:</i> 1 to 9999 <i>Artifact reject inhibit range:</i> $\pm$ 1 to $\pm$ 5 div in 0.1 div steps, Off <i>Waveform storage capacity:</i> Depends on the hard disk free space of the PC unit

<b>Display</b>	<i>Number of examination windows:</i> Up to 8 <i>Waveform display mode:</i> Monitor (free run), sweep (trigger), average <i>Cursor:</i> Two vertical or horizontal lines for time or amplitude measurements, one vertical line for mark set <i>Scale:</i> 5, 10, 15, 20 div <i>Grid:</i> Line, dot, off stimulator common functions
<b>Triggers</b>	<i>Number of channels:</i> 6 <i>Trigger mode:</i> Recurrent, random, foot switch, single stimulation, signal 1 to 5, somato 1, somato 3, external 1 to 6 <i>Trigger wave mode:</i> Single, double, train
<b>Stimulation rate</b>	<i>With the list box:</i> 0.1 to 0.9 Hz in 0.1 Hz steps, 1 to 10 in 1 Hz step, 13, 15, 17 Hz, 20 to 100 Hz in 10 Hz steps (within $\pm$ 5% of the preset value $\times$ 0.95) <i>With the keyboard:</i> 0.1 to 100 Hz in 0.1 Hz steps (within $\pm$ 5%)
<b>Delay time</b>	<i>With the list box:</i> 0 to 9 ms in 1 ms steps, 10 to 90 ms in 10 ms steps, 100 to 900 ms in 100 ms steps, 1 to 10 s <i>With the keyboard:</i> 0 to 10 s in 0.01 ms steps
<b>Electric stimulators</b>	<i>Number of channels:</i> 2 (monophasic/ biphasic stimulation, high current stimulation) <i>Output mode:</i> Constant current <i>Output current:</i> Monophasic/biphasic stimulation, 0 to 100 mA (load resistance: 1 k $\Omega$ , step can be selected from 0.05, 0.1, 0.2, 0.5, 1 mA) <i>High-current stimulation:</i> 0 to 200 mA (load resistance: 1 k $\Omega$ , step can be selected from 0.05, 0.1, 0.2, 0.5, 1 mA) <i>Stimulation pulse duration:</i> 0.05-1.0ms $\pm$ 10% 0.05ms when stimulus is greater than 2mA, $\pm$ 20% 0.03ms when stimulus is less than 2mA <i>Number of outputs on the stimulation pod:</i> 5 available <i>Biphasic stimulation mode:</i> Positive, negative, bipolar, alternate <i>Temperature measurement:</i> 0 to 45°C (32 to 113°F) $\pm$ 0.1°C (0.18°F)

## Auditory stimulators

Examination side	Left, both, right
Stimulation waveform	Click, tone burst
Stimulation phase (polarity)	Condensation (positive), rarefaction (negative), alternating stimulation
Intensity	0 to 135 dB SPL (within $\pm 2$ dB) contra-lateral white noise masking: -10, -20, -30, -40, -50 dB or off (within $\pm 5$ dB)
Click-pulse duration	0.1, 0.2, 0.3, 0.5, 1 ms (within $\pm 5\%$ )
Tone-burst frequency	<i>With a list box:</i> 125, 250, 500, 1 k, 1.5 k, 2 k, 3 k, 4 k, 6 k, 8 kHz (within $\pm 5\%$ ) <i>With a keyboard:</i> 50 Hz to 10 kHz (within $\pm 5\%$ plateau time of tone burst) <i>With a list box:</i> 0, 1, 2, 5, 10, 20, 50, 100, 200, 500, 1000 ms (within $\pm 5\%$ ) <i>With a keyboard:</i> 0 to 1,000 ms in 1 ms steps (within $\pm 5\%$ )
Rise/fall time of tone burst	<i>With a list box:</i> 0.1, 0.2, 0.3, 0.5, 1, 2, 3, 10 ms (within $\pm 5\%$ ) <i>With a keyboard:</i> 0.1 to 3000 ms in 0.1 ms steps (within $\pm 5\%$ )

## Visual stimulators

Stimulation modes	Pattern reversal, LED goggles, external visual stimulation
Pattern reversal	<i>Field format:</i> Full, left, right, upper, lower, upper left, lower left, upper right and lower right field <i>Patterns:</i> Checkerboard, horizontal bars, vertical bars <i>Number of horizontal divisions:</i> 4, 8, 16, 32, 64, 128 <i>Brightness:</i> More than 80 cd/m <sup>2</sup>
Side	Left, right, both

## External units (option)

External input	8 ch, 0.2, 1 V/div
External output	8 ch 1 V/div (5 kHz at 1 ch, 200 Hz at 8 ch)
Line I/O	Available
Trigger input	6 channels
Amplitude	More than 4 V (positive), less than 0.5 V (negative). Available for pulse whose duration is more than 10 $\mu$ s, either positive and negative can be selected
Pulse duration	1, 5, 10 ms; Either positive and negative can be selectable
Response switch	When closed, operates at low level
Digital input	When closed, operates at low level 6 ch
Amplitude	Less than 0.5 V (negative); Available for pulse whose duration is more than 1 ms

## Dimensions and weight

Main Unit	390(W) x 55(H) x 304(D) mm, 3.2 kg
Electrode junction box	180(W) x 56.5(H) x 234.5(D) mm, 1.5 kg
Constant current stimulator unit	56.5(W) x 190(H) x 240(D) mm, 1.0 kg
Somato control box	37(W) x 62(H) x 21(D) mm, 0.16 kg
Control panel unit	253(W) x 100(H) x 300(D) mm, 1.0 kg
Multi-interface box	160(W) x 24(H) x 120(D) mm, 0.8 kg

## Power requirements

Line voltage and frequency	220 to 240 V, 50Hz
Power unit	1200 VA

## Operating environment

Temperature	10 to 35 °C (50 to 95 °F)
Humidity	30 to 80 % (non-condensing)
Atmospheric pressure	700 to 1060 hPa

## Storage and transport

Temperature	-20 to 65 °C (-4 to 149 °F)
Humidity	10 to 95 % (non condensing)
Atmospheric pressure	700 to 1060 hPa



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