

Spike2

Version 7



Life sciences data acquisition & analysis system

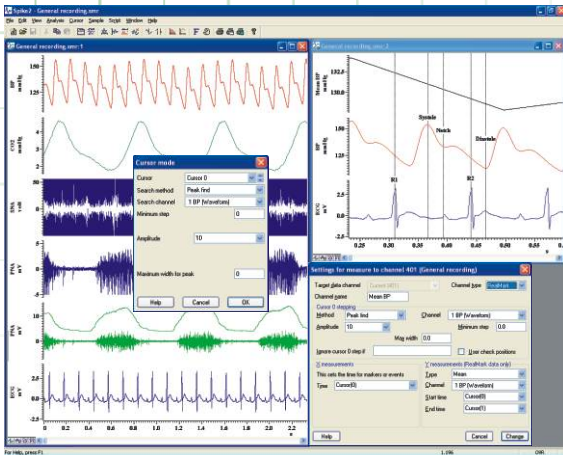
Spike2 is the data acquisition system of choice for thousands of researchers worldwide. Whether you require simple data capture or a complete package for experiment control, recording and analysis, Spike2 has many advantages over other data acquisition systems.

- Spike2 includes recording and analysis features suitable for a wide range of research applications. You do not need to purchase add-on modules for specific tasks
- Spike2 has the power and flexibility for demanding applications for which you would expect to require more specialised equipment, for example extracellular multi-electrode recording and complex stimulus timing and delivery
- Spike2 has the sampling and analysis features most researchers need. There is also a built-in script language which provides flexibility far beyond that available from many alternative products, allowing automation of repetitive tasks and providing many additional tools for researchers who prefer to write their own applications
- Spike2 can import data recorded by many other systems, so that you can take advantage of this extremely versatile software to analyse existing data
- Spike2 can export data to spreadsheet, text, binary and Matlab files

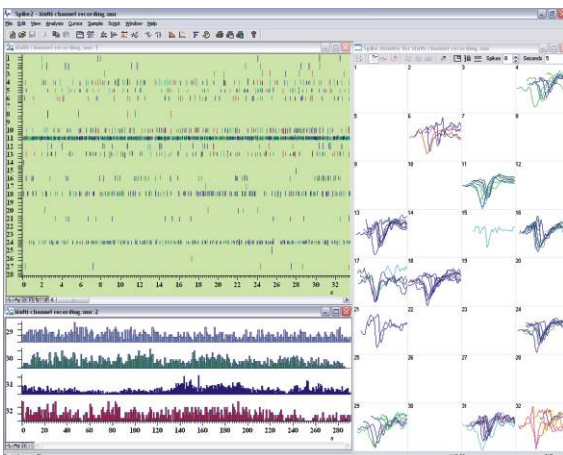
The powerful data capture and time-saving analysis functions of Spike2 together with one of the CED 1401 family of laboratory interfaces make an extremely valuable and cost-effective addition to any laboratory.

Features

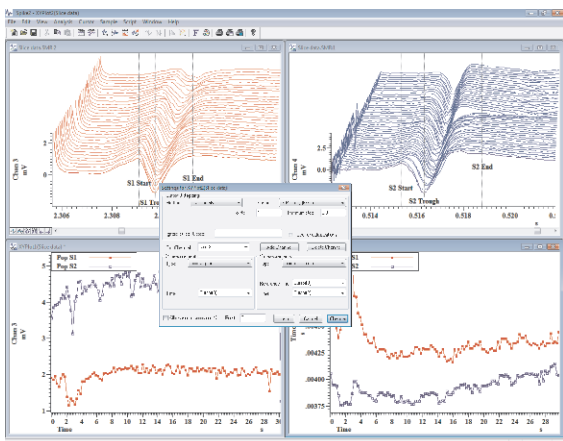
- Navigate through your data quickly and simply using the intuitive user interface; zoom and scroll with the mouse or keyboard
- Record multiple data types, including waveforms, event times, coded markers, and discriminated single or multi-unit spike data in real-time
- Generate simple and complex protocols of waveform and pulse outputs
- Detect features manually or automatically and take measurements based on triggered and cyclical data
- Analyse multiple channels of waveform and event data on-line and off-line
- Process data with functions including: filtering, rectification, interpolation and inter-channel arithmetic
- Display and export images as you want them, with versatile display options including: triggered update with optional overdraw and 3D display and duplicated windows with independent display settings
- Record very large numbers of channels by synchronising multiple CED 1401s to a master 1401 unit
- Customise the program with the built-in script language that provides control from simple automation to addition of complex analysis functions
- Replay data files, with simultaneous output of waveform data through 1401 DACs or computer sound card
- Record video and audio alongside Spike2 data files



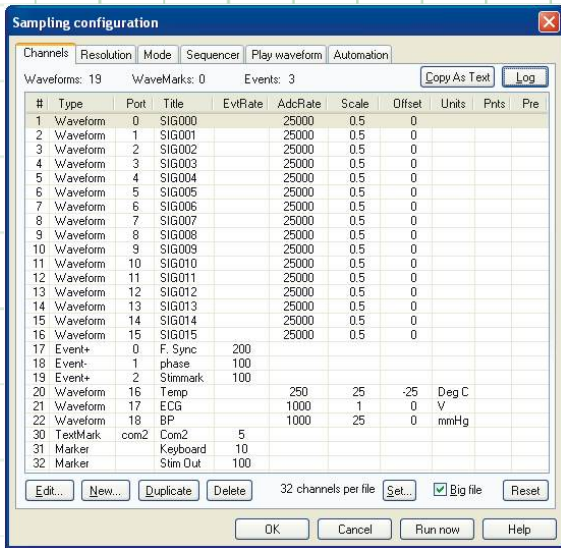
ECG recording with automated detection of R wave peaks and BP features, and plotting of mean BP



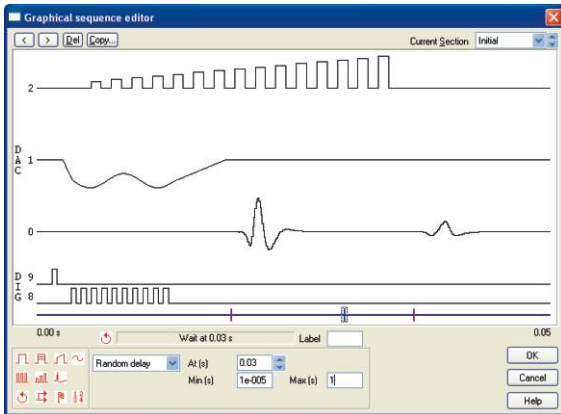
Multi-channel on-line spike discrimination with 'spike monitor' display



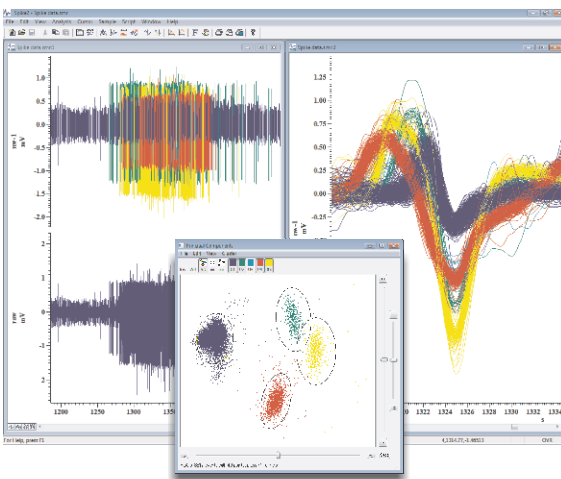
Automated measurement of population spike amplitude and latency with 3D overdraw display



Channel setup in sampling configuration



Setup of waveform and digital outputs using the graphical sequence editor



Multi-unit spike discrimination using PCA clustering

Acquisition using a CED 1401

- Set different waveform sample rates per channel
- Record large data files, up to 1TB
- Capture and classify single and multi-unit spike activity in real-time
- Continuous, internally timed and triggered recording modes
- Record multimedia video and sound, time-locked to Spike2 data
- Store up to 8 channels of event data with microsecond timing resolution
- Log accurately-timed 8-bit coded digital inputs
- Annotate data records with text notes and keyboard markers
- Swap between experiment setups quickly with a single mouse click
- Calibrate waveforms with multiple methods including values, areas, slopes
- Automatically save and sequence multiple files with optional trigger start
- Recover data files in the event of an un-commanded system shutdown
- Configure dynamically programmable amplifiers including the CED1902 low-noise isolated pre-amplifier

Experiment control and stimulus sequencing

The Spike2 output sequencer can run complex experiment control and stimulus sequencing protocols during data capture using up to 16 TTL and 8 waveform outputs. Timing is precise as it is controlled at the CED 1401 interface, not the host computer.

Output protocols can be set up in two ways. A graphical editor provides all the functionality most users require, allowing creation of multiple sets of pulse outputs including square pulses, sine waves, ramps, pre-recorded and user-defined waveforms. For more demanding applications, a text editor is available in which you can edit the sequencer steps directly. This makes it possible to control the sequence interactively through the script language by use of variables and tables.

The sequencer also has access to the incoming waveform and event data in real-time, enabling very fast response to changes in waveform levels and detection of events.

Spike detection and sorting

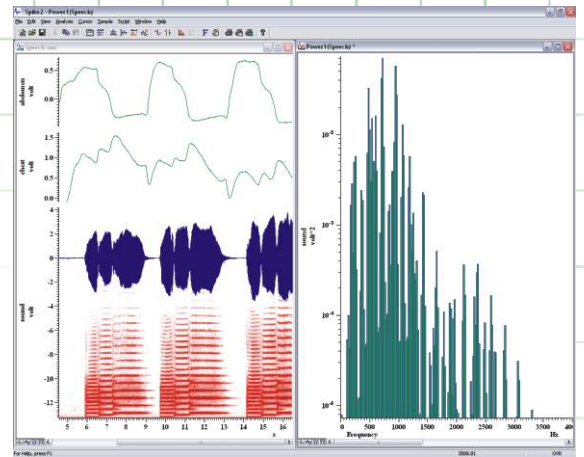
Spike2 identifies and sorts single and multi-unit activity both on-line and offline. It can mark events using simple threshold crossings or sort up to 32 channels on-line with whole wave spike shape template matching of single trace and n-trade data.

For multi-unit recordings, Spike2 contains tools for sorting spikes based on the spike waveform shape. All events crossing a threshold are captured. A combination of template matching and cluster cutting based on Principal Component Analysis (PCA), user-defined measurements correlations or errors is then used to sort spikes into different units. Spikes can also be sorted interactively by simply drawing a line through overdrawn spikes and classifying any which intersect the line. Spike Collision Analysis can separate unit collisions by comparing the current spike shape with pairs of existing templates

Cluster cutting methods plot measured values into a 3D view that can be rotated and replayed to show the occurrence of the spikes through time. Clusters are formed by automatic algorithms or manually by placing ellipses or drawing polygons. Interactive features include INTHs for current cluster classes, tracking over time, and selection of an individual spike by clicking on its dot in the cluster.

Display

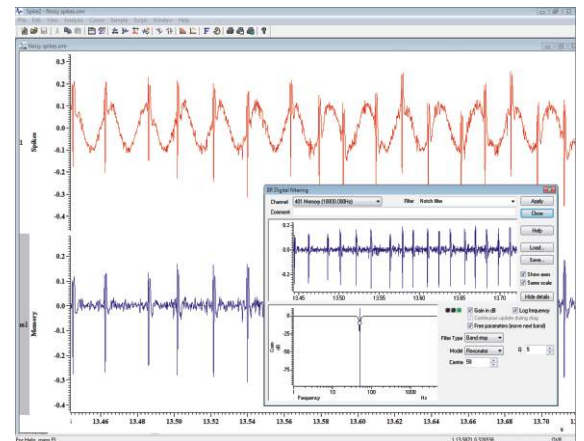
- Review multiple files simultaneously, even when sampling
- Navigate through data files with simple mouse pan and zoom, axis dragging, scroll bar and keyboard control
- Display events, spikes and markers as times, rates, mean and instantaneous frequencies. Discriminated spikes can be overdrawn
- Use duplicated channels to display data in different ways and show selected markers and discriminated spikes separately for cross analysis
- Overlay multiple triggered 'sweeps' with optional 3D display
- Draw waveforms with optional linear and cubic spline interpolation or as frequency sonograms with preset and user-defined colour scales
- Draw marker type data in State mode for condition marking. Textmark (text note) channels can also display stored text in the channel area
- Vertical marker option extending down entire data view
- Set independent colours for each channel's data and background
- Arrange vertical space and order of channels displayed, including option to overlay multiple channels
- Logarithmic axes display option for result and XY views
- Expand your display area with built-in multiple monitor support



Frequency analysis showing waveform sonogram display and calculated power spectrum with log axes

Processing and Analysis

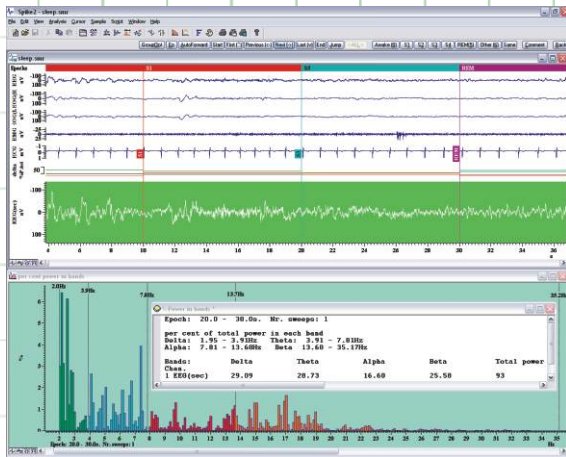
- Waveform analyses including averaging, power spectra and waveform correlations
- Event analyses including INTH, PSTH, auto and cross correlations and phase histograms
- Automatically find data features including triggers and features in evoked, spontaneous activity and cyclical data with 'active' cursors
- Generate XY plots and measurement channels in data files and output tables of values based on cursor feature detection
- Take absolute and relative measurements of positions, data values and inter-cursor statistical measurements with up to 10 active cursors per view
- Quickly take time and amplitude measurements by simply dragging the mouse pointer
- Derive 'virtual channels' from existing waveform and event channels defined by user-supplied expressions (channel arithmetic). Options include mathematical functions and comparison operators
- Generate functions in 'virtual channels', including sine, square, triangle waves, envelopes and polynomials
- Process waveforms dynamically on- and off-line. Processes include rectify, smooth, DC remove, downsample, interpolate, median filter and RMS amplitude
- Create editable temporary channels containing copied or derived data
- Digitally filter waveforms (FIR and IIR) with interactive filter design
- Interactively fit data with functions including exponential, Gaussian, polynomial, sinusoid and sigmoid
- Automate repetitive, multi-step and custom analyses using the script language



Interactive IIR notch filter applied to reduce mains artefact



Script driven multi-unit cross correlation analysis



Scripted sleep stage scoring and analysis

Script language

From complete beginners to experienced programmers, anybody can benefit from the built-in Spike2 script language. Even simple automation of repetitive tasks with known parameters can save hours or even days of tedious analysis. Advanced applications include complete experiment control with on-line application of original algorithms to sampled data in real-time.

The script language not only links Spike2's features but also allows you to generate your own interface and design algorithms. There is a simple macro recording facility to provide a starting point for new scripts. The script language also includes data manipulation tools such as multi-dimensional arrays and matrix functions.

CED maintains a collection of scripts for a wide range of common and specialised applications. If the scripts included with the Spike2 software and available via the CED web site do not meet your needs, contact us to discuss your requirements.

Service and Support

When you buy a system from CED, you are buying from a company with over 39 years of experience in data acquisition. We have one of the best customer support packages currently available, which includes:

- Free software and hardware help desks
- Software and hardware development responsive to user feedback
- Swift fault diagnosis and hardware servicing
- Software updates available free within major revisions
- 3 year warranty on major hardware
- Regular email newsletters
- Invitations to CED training days
- Register on the user forum to post questions for the CED team and browse topics posted by ourselves and other CED users



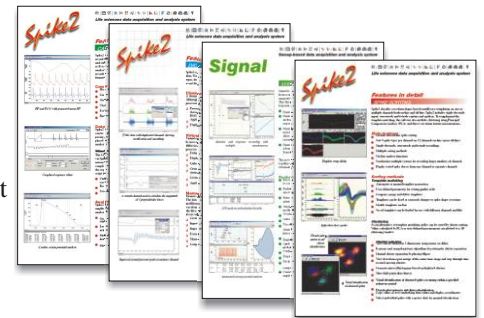
Spike2 user training days

System requirements

Spike2 version 7 requires a CED Micro1401, Power1401 or 1401*plus* intelligent laboratory interface and a PC with Windows NT 2000, Windows XP, Windows Vista or Windows 7, Intel Macintosh running Windows. We recommend that the PC has 2GB minimum of RAM.

Further information

Additional information sheets on specific aspects of the Spike2 software and applications areas, as well as our episodic capture and analysis software, Signal are available from CED. Please contact us or visit the web site.



The Micro1401-3 and Power1401 mkII



1902 isolated pre-amplifier

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