Applied Biosystems

Applied Biosystems 3130 and 3130*xl* Genetic Analyzers.

System Profile

Applied Biosystems 3130 and 3130*xl* Genetic Analyzers

Table of Contents

A Powerful Blend of Flexibility and Performance 1

Ease-of-Use 1

Key Features 2

- Capillary Electrophoresis 2
- Automated Polymer Delivery System 2
- Enhanced Thermal Control 2
- High-Perfomance Capillaries and Electro-osmotic Flow Suppression (EOF) Polymers 2
- Detection Method Designed for Sensitivity 3
- Spectral Array Detection 3

Application Flexibility 4

- Complete System Optimized for Multiple Applications 4
- One Polymer, One Array, Maximum Performance 4
- System Software Suite 5

Results 6

Summary 9

References 10

A Powerful Blend of Flexibility and Performance

Applied Biosystems has a long tradition of providing excellence in life science instruments, reagents, and software. This tradition of pioneering and innovation in the field of genetic analysis continues with the introduction of Applied Biosystems next-generation systems, the 3130 and 3130*xl* Genetic Analyzers.

The 16-capillary 3130*xl* Genetic Analyzer and the upgradable 4-capillary 3130 Genetic Analyzer give you all the benefits of the Applied Biosystems suite of fluorescence-based capillary electrophoresis (CE) systems.

Both systems offer industry-leading performance, plus sophisticated automation capabilities that make the most of your time and increase your lab's productivity.

The versatile, next-generation 3130 Series Systems deliver higher data quality, faster turnaround times, improved automation, and greater reliability across the complete range of sequencing, resequencing (mutational profiling), and fragment analysis applications.

4-capillary 3130 Genetic Analyzer:
Upgrade whenever you're ready.

The flexible, 4-capillary 3130 system gives you all the advanced automation and superior performance of the Applied Biosystems 3130*xl* platform, with acquisition and operating costs tailored to an expanding research lab. And as your throughput needs increase, the system can be easily upgraded to 16 capillaries.

It's the perfect way to obtain the capacity and savings you need today—without limiting your growth options.

16-capillary 3130*xl* Genetic Analyzer:
High-performance workhorse.

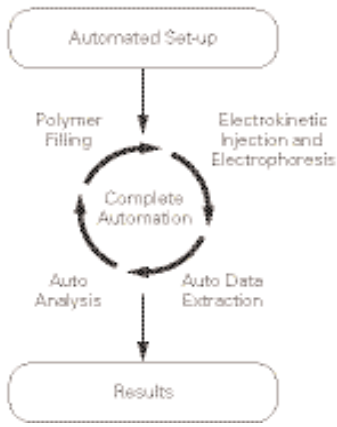
With 16-capillary throughput and advanced automation capabilities, the 3130*xl* system is flexible enough to meet the throughput needs of the busiest core facility or research group. The streamlined set-up and 24-hour unattended operation make it an ideal choice for low or medium throughput laboratories.

Ease-of-Use

Complete automation.

At every scale, Applied Biosystems genetic analyzers are known for their advanced automation and "hands-free" operation. The Automated Polymer Delivery System eliminates manual washing and filling of polymer syringes, significantly reducing the time required for instrument set-up and maintenance. All steps are automated, including polymer loading, sample injection, separation and detection, and data analysis. After placing plates on the autosampler and importing sample information, just select the "Start Run" command. You can even pause the instrument during the pre-run of each sample set to add samples.

3130 Series Systems Workflow



Compatibility.

The 3130 Applied Biosystems Series Systems provide an easy transition from the ABI PRISM® 310 and 377 systems, and they are fully compatible with the production-scale 3730 Series Systems. We use the same chemistry kits, and leverage the same technologies that are featured in our larger, production-scale instruments—an important consideration for labs wishing to standardize on a common platform. Additionally, the systems share a consistent software interface, and all data are generated in ABI Format (ABIF), which is compatible with existing application software systems.

Long-term reliability.
Laboratories require an instrument they can trust to handle their workload, and the 3130 Series Systems deliver. Robust engineering and extremely low maintenance requirements make this the platform of choice for high-usage and multiple-user environments. You can count on higher data quality, improved automation and ease-of-use, and faster turnaround times across the complete range of sequencing, resequencing, and fragment analysis applications.

Key Features

Capillary electrophoresis.
Capillary electrophoresis offers several performance advantages for DNA analysis, compared with slab-gel techniques. The efficient heat dissipation of capillaries, along with a detection cell heater, provides enhanced thermal control, which results in more consistent runs and faster run times. Capillary electrophoresis also allows the use of electrokinetic injection to load samples into the capillaries; samples are simultaneously injected into the parallel 4- or 16-capillary array in less than 30 seconds.

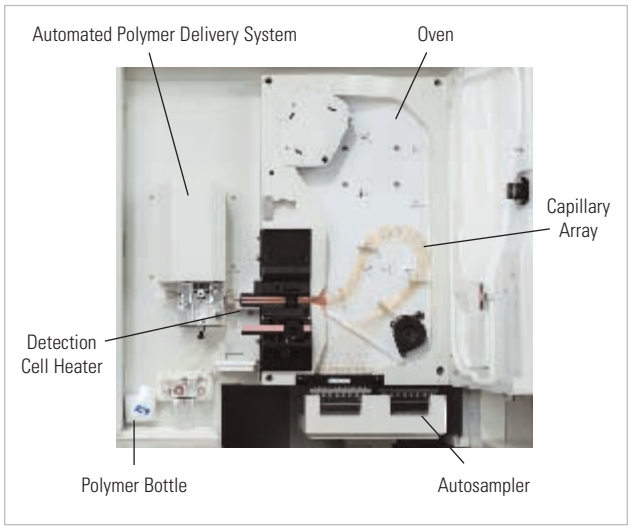
Sample usage is also reduced. Capillary electrophoresis, combined with a sensitive detection system, requires less DNA per sample than slab-gel technology.

The most dramatic advantage of capillary electrophoresis, however, is the elimination of manual operations, resulting in improved run-to-run consistency and reliability—as well as faster turnaround times.

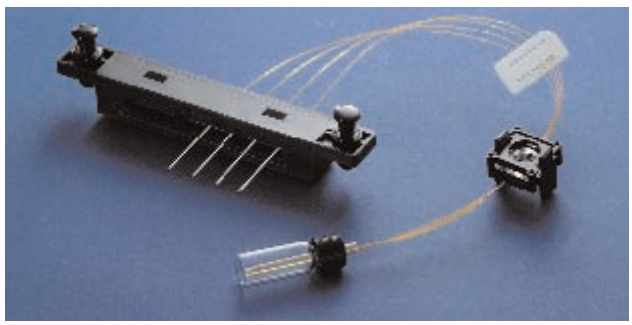
Automated polymer delivery system.
The 3130 Series Systems require from you only sample preparation and creation of sample information for 24-hour continuous, unattended operation. Instrument set-up consists of filling the buffer reservoirs and attaching the polymer bottle.

- Flowable polymer is loaded into the capillaries prior to each run.
- Samples are injected and run according to conditions you specify.
- Data is collected and analyzed; the files are then available for direct transfer to a database for further analysis and reporting.
- Up to 384 samples can be scheduled to run without interruption.

Following electrophoresis, the Automated Polymer Delivery System automatically flushes and replenishes the capillaries with fresh polymer. After the capillary array has been filled, the next set of samples is automatically injected directly from either 96- or 384-well sample plates.



Enhanced thermal control.
The detection cell heater offers superior resolution and sizing precision, as well as improved thermal control. The new, higher temperature (60°C) 3130 POP-7™ Polymer run modules take advantage of the enhanced thermal control and improve run-to-run consistency. They also help reduce GC-rich secondary structures, leading to improved capillary electrophoretic analysis. In addition, improved thermal control and the use of advanced 3130 POP-7™ Polymer enable longer read lengths, faster turnaround times, and superior performance compared to slab-gel or other capillary-based systems.



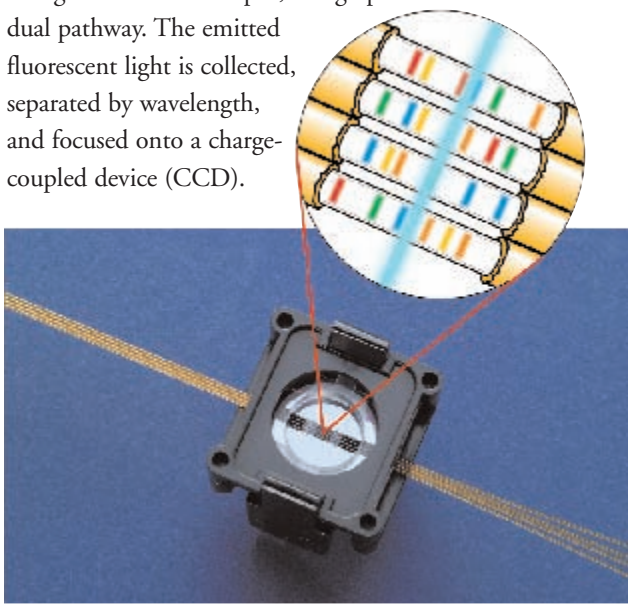
Four-capillary array.

High-performance capillaries and electro-osmotic flow suppression (EOF) polymers.
In capillary electrophoresis, the ionic double layer at the surface of the capillary wall must be immobilized to suppress electro-osmotic flow (EOF). Suppression of electro-osmosis

enables DNA to migrate from the cathode toward the anode without the influence of bulk fluid flow. A variety of methods can be used to neutralize the surface of the capillary wall. Most involve applying a bonded phase during the manufacturing process of the capillary bundles. These covalent coatings can be problematic, however, because they degrade over time, resulting in decreased performance and a shorter capillary life.

The capillaries used in the 3130 Series Genetic Analyzers are manufactured without an interior coating to eliminate problems associated with degradation. In addition, the ion boundary at the surface of the capillaries is immobilized by specially formulated polymers, which is renewed each time the capillaries are filled with polymer to prevent electro-osmotic flow.

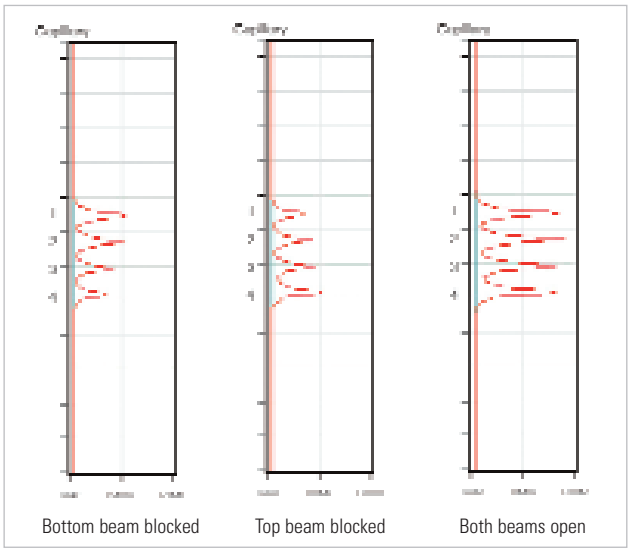
Detection method designed for sensitivity.
The key to cost-effective and accurate nucleic acid analysis is uniform maximization of the amount of signal per sample. The detection system in the 3130 instruments is designed with this in mind. As the DNA passes through the detection cell, a laser beam simultaneously illuminates the capillaries from both sides of the array. To accomplish this, light from a single laser source is split, using optical elements to form a dual pathway. The emitted fluorescent light is collected, separated by wavelength, and focused onto a charge-coupled device (CCD).



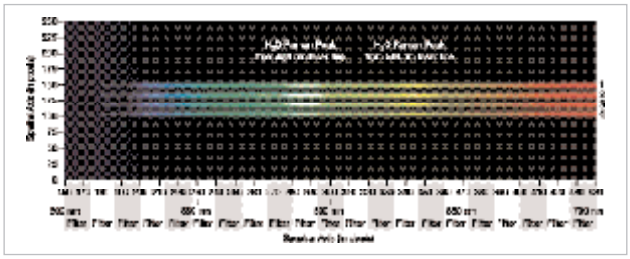
Close-up image of capillary array detection cell with a stylized schematic representation of in-capillary detection.

Spectral array detection.
When the fluorescent light has been collected and dispersed across the CCD, the data are transferred to the instrument computer where they are transformed by chemometric algorithmic processing into 4- or 5-dye electropherograms. This method of collecting and imaging light has several advantages:

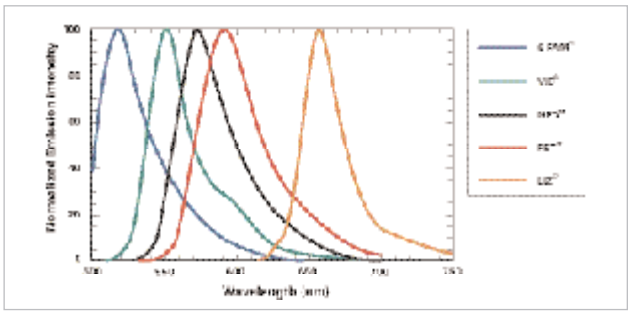
1. It greatly reduces the experimental noise in the dye electropherogram through the use of spectral over-sampling.
2. It prevents the time-interpolation problem by simultaneously collecting all the colors.
3. It provides the versatility required to adapt new chemistries and dye sets as they become available without requiring changes in the optical hardware, as is the case with fixed optical filter systems.



Intensity profile through a 4-capillary array filled with polymer.



Full-frame CCD camera image of a 4-capillary array filled with polymer, colorized to show wavelength dispersion and cropped to show collection range. This image shows that the system has the sensitivity to detect the Raman scattering of water in the polymer associated with the 488 nm and 514 nm laser lines.



Emission spectra of GeneScan™ dyes used with the 3130 Series Systems.

Application Flexibility

Complete system optimized for multiple applications. The 3130 Series Systems are more than just DNA sequencers. This versatile platform has been designed for easy conversion between applications with minimal intervention on your part. You can achieve reproducible results from both sequencing and fragment analysis chemistries for a wide variety of applications: *de novo* sequencing; comparative sequencing; genome finishing and contig assembly; construct validation; large template sequencing; microsatellite analysis; and SNP discovery, validation, and screening.

One polymer, one array, maximum performance. Genetic analysis researchers often must run a wide variety of applications. Optimizing parameters for maximum data quality can be costly and time-consuming. A flexible instrument that easily lends itself to various applications is, therefore, essential. The instrument must be able to analyze both sequencing and fragment analysis samples quickly and accurately with a single array and polymer, thus minimizing hands-on time. Researchers who choose the 3130 Series Genetic Analyzers can perform multiple applications using just one array and one polymer configuration to generate

Performance and Throughput

Sequencing Run Modules

Sequencing Run Modules	Array Length	Polymer	Run Time (min)	24-hr Throughput*		KB™ Basecaller Q_{20} LOR**†
				3130 Analyzer	3130*xl* Analyzer	
UltraSeq36_POP7	36 cm	POP-7	35	164	656	500
RapidSeq36_POP7	36 cm	POP-7	60	96	384	600
UltraSeq36_POP4	36 cm	POP-4	40	144	576	400
RapidSeq36_POP6	36 cm	POP-6	60	96	384	500
FastSeq50_POP7	50 cm	POP-7	60	96	384	700
StdSeq50_POP7	50 cm	POP-7	120	48	192	850
StdSeq50_POP4	50 cm	POP-4	100	56	224	600
StdSeq50_POP6	50 cm	POP-6	150	36	144	600
LongSeq80_POP7	80 cm	POP-7	170	32	128	950
LongSeq80_POP4	80 cm	POP-4	210	24	96	700

** Number of samples*
***Sequencing Analysis Software v5.2 provides a metric Length Of Read (LOR), defined as the usable range of high-quality or high-accuracy bases determined by Quality Values (QV) generated by KB Basecaller Software v1.2. The LOR is determined using a sliding window of 20 bases, which have an average QV greater than 20.*
† 98.5% basecalling accuracy, less than 2% N's.

Fragment Analysis Run Modules

Fragment Analysis Run Modules	Array Length	Polymer	Run Time (min)	24-hr Throughput		Resolution (bp)	Performance SD**
				3130 Analyzer GT*	3130*xl* Analyzer GT*		
Fragment Analysis 22_POP4	22 cm	POP-4	20	5,760	23,040	400	0.50
SNP22_POP4	22 cm	POP-4	15	3,840***	15,360***	120	0.50
Fragment Analysis 36_POP7	36 cm	POP-7	35	3,280	13,120	500	0.15
Fragment Analysis 36_POP4	36 cm	POP-4	45	2,560	10,240	500	0.15
HID Fragment Analysis 36_POP4	36 cm	POP-4	45	2,560	10,240	500	0.15
SNP36_POP4	36 cm	POP-4	30	3,840	15,360	120	0.15
Fragment Analysis 50_POP7	50 cm	POP-7	50	2,240	8,960	500	0.15
Fragment Analysis 50_POP4	50 cm	POP-4	65	1,760	7,040	500	0.15
Fragment Analysis 50_POP6	50 cm	POP-6	90	1,280	5,120	500	0.15

**20 genotypes/injection*
***Standard deviation: 1 base pair (bp) resolution at 99.99% accuracy*
****10 genotypes/injection*

high-quality sequencing and fragment analysis data. Additionally, they can choose from multiple configuration options that meet their workflow and application needs.

System software suite.
The 3130 Series Systems integrate seamlessly with several downstream software packages:

- **Sequencing Analysis Software**—designed to analyze, display, edit, save, and print sequencing data. Generation of quality values provides accurate basecall information for pure and mixed base calls.
- **SeqScape® Software**—used for mutation detection and profiling. Basecalling algorithms seek out mixed bases for comparative sequencing, SNP discovery, and validation. With comparisons to a reference sequence, many samples can be analyzed and assembled simultaneously for fast and accurate determination of mutations.
- **GeneMapper® Software**—the most comprehensive fragment analysis software available. Multiple application features make it an ideal tool for genotyping, allele calling, fragment sizing, and SNP analysis. Quality Values (QV) are assigned to each fragment analyzed for easy automation and throughput, and questionable fragments are easily identified. Applications include microsatellite analysis (diploid and polyploid), linkage mapping, SNP analysis (including SNaPshot® Kits), AFLP, relative fluorescent quantitation including loss of heterozygosity, and conformational sizing.

Sample information, including plate name and sample-well location, can be easily imported into the software of the 3130 Series Systems, saving time and minimizing potential errors. The system's integrated Data Collection Software provides control, maintenance, and calibration of the instrument and system self-tests. It also provides an industry-standard database that stores all the information necessary for set-up and operation, as well as a run history for instrument diagnostic purposes.

Many parameters, including those for electrophoretic injection and separation, collection, and auto analysis settings, can be adjusted via the user interface. This allows the instrument to operate with maximum flexibility.

A wide range of software options enables automated data analysis, storage, and sample tracking. The 3130 Series Systems operate in the Windows XP® environment and have the flexibility to export data via two options. Researchers can automatically create ABIF sample files for stand-alone analysis or transport ABIF files to a custom data-management system. Data can be reviewed with DNA Sequencing Analysis software, SeqScape® software, or GeneMapper® software, and they can then be viewed, analyzed, and edited.

Sequencing Analysis Reagents

Application Kit	Applications
BigDye® Terminator kits	*de novo* sequencing comparative sequencing
dRhodamine Terminator kits	*de novo* sequencing comparative sequencing
dGTP BigDye® Terminator kit	Difficult template sequencing

Fragment Analysis Reagents

Application Kit	Applications
Linkage Mapping Set v2.5-HD5	Genome-scale screening with dinucleotide microsatellite markers at ~5 cM resolution
Linkage Mapping Set v2.5-MD10	Genome scale screening with dinucleotide microsatellite markers at ~10 cM resolution
GeneScan™-400HD ROX™ Size Standard	Sizes unknown DNA fragments precisely and automatically
GeneScan™-500 ROX™ Size Standard	Sizes unknown DNA fragments precisely and automatically
GeneScan™-120 LIZ® Size Standard	Sizes unknown DNA fragments precisely and automatically
GeneScan™-500 LIZ® Size Standard	Sizes unknown DNA fragments precisely and automatically
SNaPshot® Multiplex Kit	SNP analysis by single-base extension
AFLP® Mapping Kit	AFLP analysis for plants and microbes

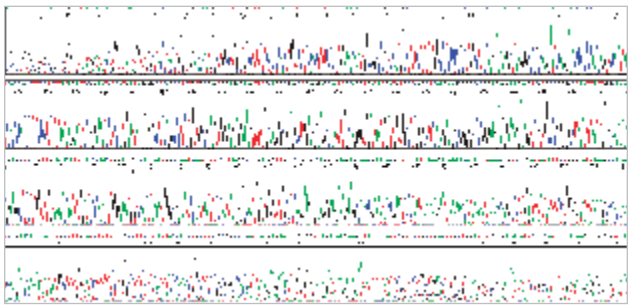
Please contact Applied Biosystems about application kits for:

- Disease Research Identification
- Human Identification
- Microbial Identification
- Agriculture

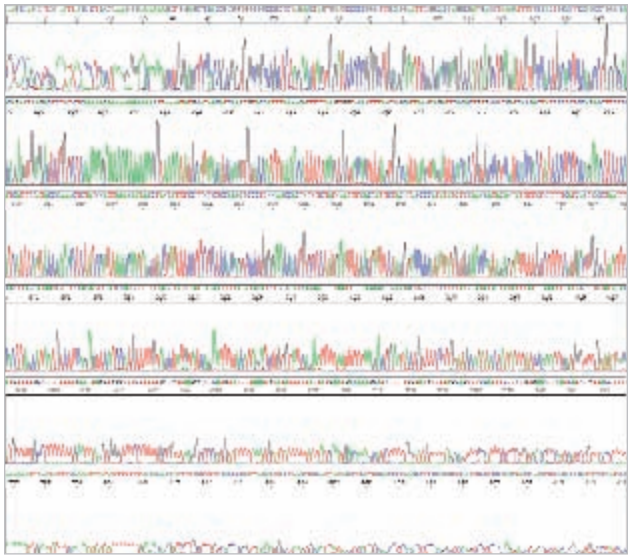
Results

Sequencing analysis data.

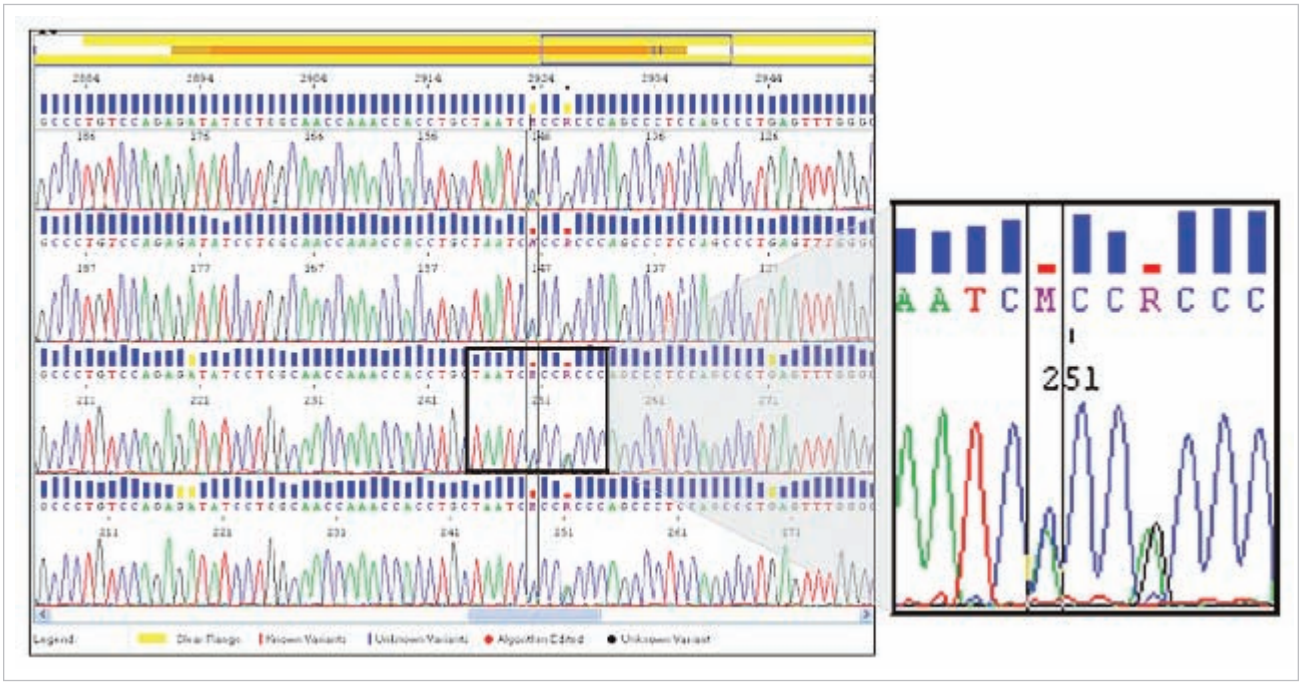
Results indicate that the 3130 Series Systems have ample peak-resolution uniformity to perform heterozygote identification or achieve read-lengths greater than 950 base pairs. In addition, the systems support multiple run modules that provide the high degree of flexibility required to meet a wide range of research needs.



Example of a typical sequencing run using the Ultra-Rapid Sequencing module. The run was performed using BigDye® Terminator Sequencing Standard v3.1. A 668 bp length-of-read was achieved for this sample using 3130 POP-7™ Polymer and the 36 cm capillary array. The total run time was 35 minutes.



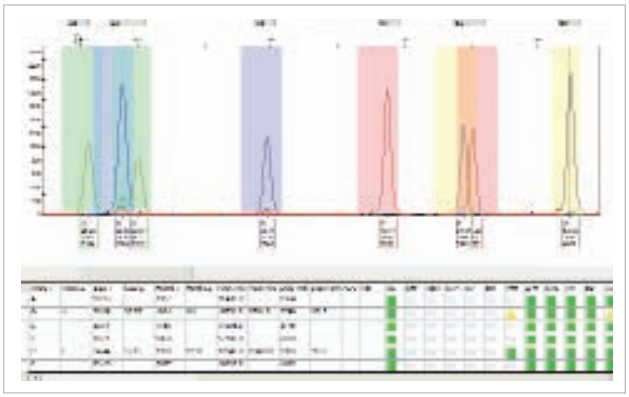
The electropherogram from a 3130*xl* Genetic Analyzer is an example of a typical long-read sequence obtained from a BigDye® Terminator Sequencing Standard v3.1. An LOR of 1,090 bp was achieved for this sample using the 3130 POP-7™ Polymer. Total run time: 2 hours, 50 minutes.



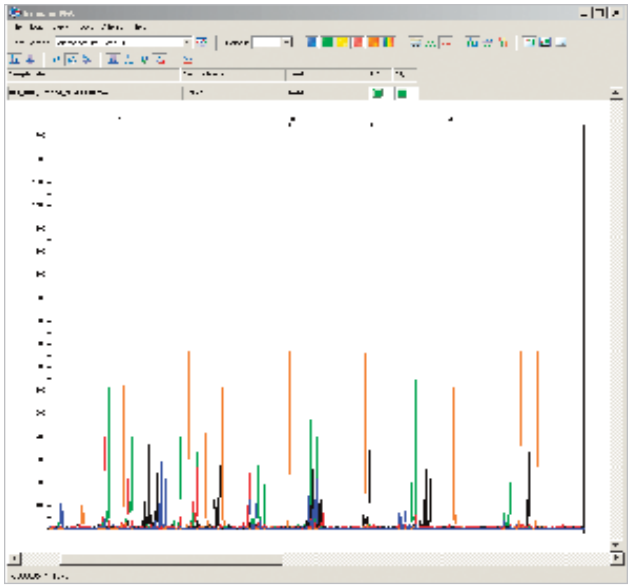
Heterozygote detection using SeqScape® Software v2.5. Three variants of the CCL24 gene were detected in this experiment. Two of the variants are heterozygote bases, illustrated in the consensus sequence with black dots above the base. The individual electropherogram sequence traces covering that base position are seen in both orientations. The sequencing reactions used in this experiment were perfomed using the Applied Biosystems BigDye® Terminator v3.1 Cycle Sequencing Kit protocol. Subsequently, it was purified using Centri-Sep™ spin columns. The 3130*xl* UltraSeq36_POP7 run module was used, and the samples were analyzed using KB™ Basecaller v1.2 in SeqScape Software v2.5.

Fragment analysis data.

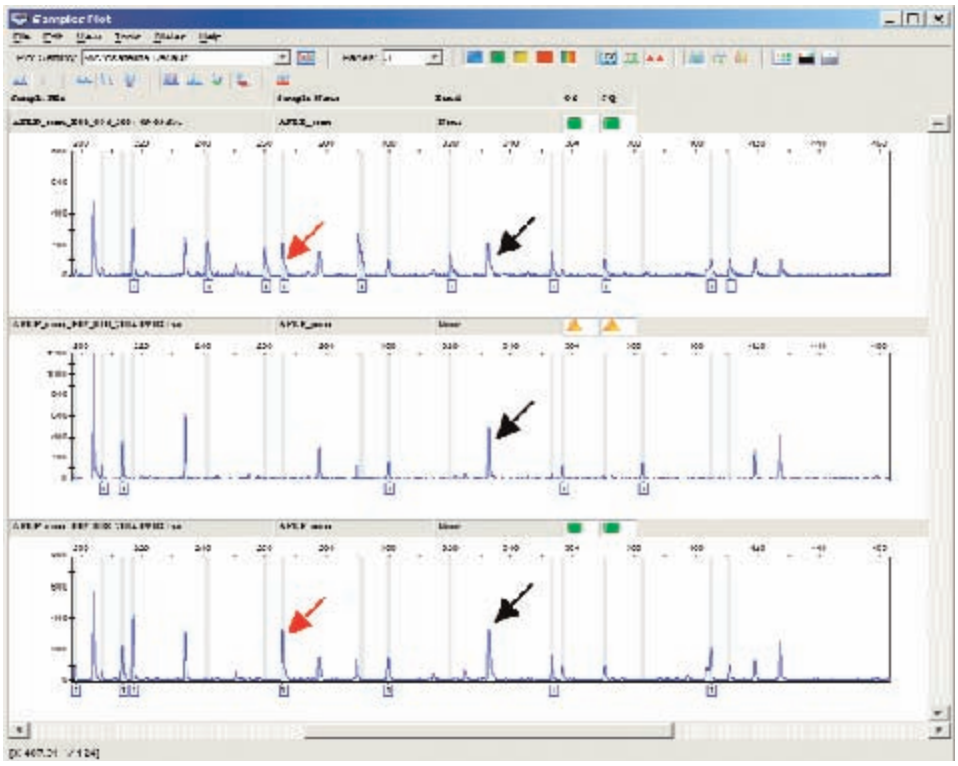
These results demonstrate the superior resolution that the 3130 Series Genetic Analyzers can achieve. The systems deliver the resolution and sizing precision required for microsatellite analysis and other fragment analysis applications to ensure correct allele identification.



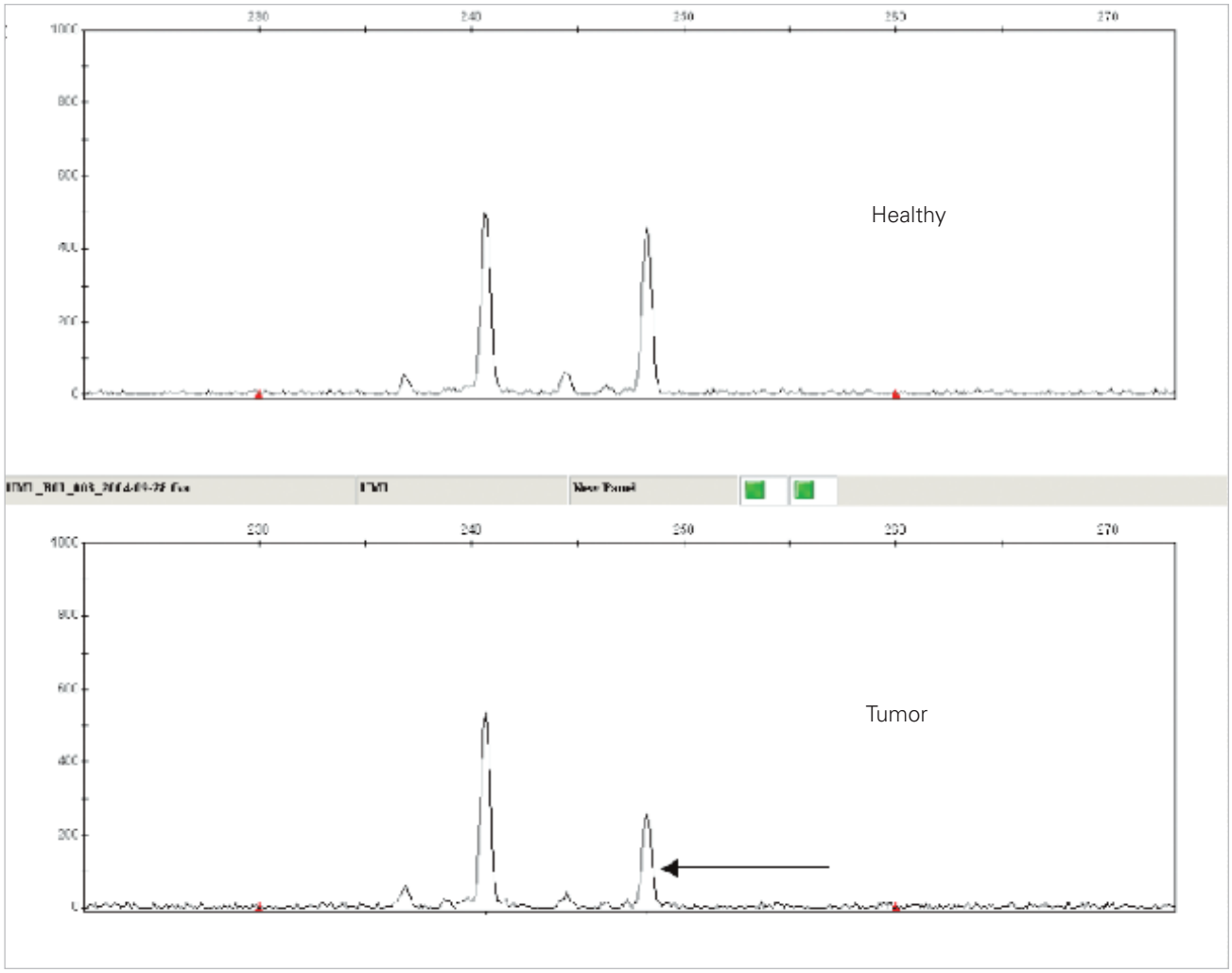
Rapid and accurate SNP genotyping can be performed on 3130 Genetic Analyzers, using the ABI PRISM® SNaPshot® Multiplex Kit. Shown is an electropherogram of a control reaction used to interrogate six SNPs in a single multiplex reaction, run on a 3130*xl* Genetic Analyzer. Genotypes are indicated by labels underneath each peak. The colored bars represent bins used for allele calling.



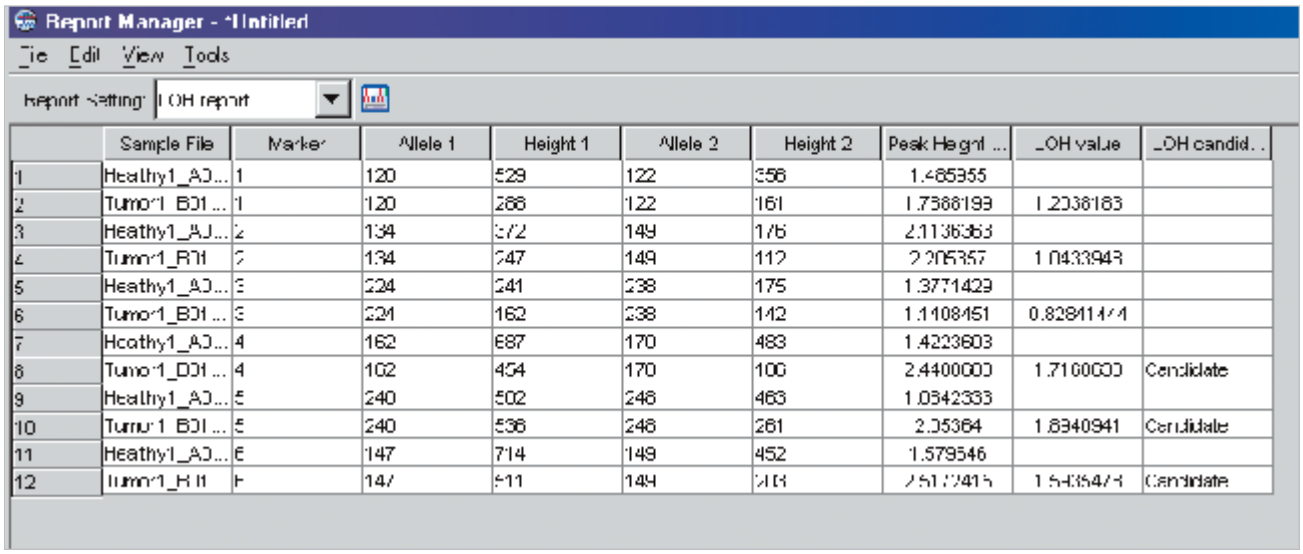
Five-dye chemistry increases the number of markers that can be run in a single capillary for improved throughput. Above is an example of 18 microsatellite loci co-electrophoresed in a single capillary.



Analysis of AFLP assay data from P1, P2, and F1 samples run on the 3130*xl* Genetic Analyzer. The black arrow indicates a common peak, and the red arrow indicates a polymorphic peak. The bins (grey bars) and allele calls are indicated on the plots.



Relative fluorescent quantitation was used on the 3130 Series System to assay for loss of heterozygosity (LOH). Reduced peak height of a microsatellite marker in a tumor sample (lower panel) as compared to the healthy sample (top panel) is indicative of possible LOH.



	Sample File	Marker	Allele 1	Height 1	Allele 2	Height 2	Peak Height ...	LOH value	LOH candid...
1	Healthy1_AD...	1	120	529	122	356	1.485955		
2	Tumor1_BD1 ...	1	120	288	122	161	1.7888199	1.2038183	
3	Healthy1_AD...	2	134	572	149	176	2.1136363		
4	Tumor1_BD1	2	134	247	149	112	2.205357	1.0433948	
5	Healthy1_AD...	3	224	241	238	175	1.3771429		
6	Tumor1_BD1 ...	3	224	162	238	142	1.1408451	0.8284144	
7	Healthy1_AD...	4	162	687	170	483	1.4223603		
8	Tumor1_DD1 ...	4	162	454	170	100	2.4400000	1.7160000	Candidate
9	Healthy1_AD...	5	240	502	246	463	1.0842333		
10	Tumor1_BD1 ...	5	240	536	246	261	2.05364	1.8940941	Candidate
11	Healthy1_AD...	6	147	714	149	452	1.579646		
12	Tumor1_BD1	6	147	511	149	203	2.5172415	1.5935474	Candidate

Using the new Report Manager feature in GeneMapper® Software v3.7 peak height ratios can be calculated and compared, and LOH candidates can be automatically identified and flagged for further review.

Summary

Simplified workflow.
A highly sensitive system and cost-effective use of consumables keep per-sample costs within budget. Fully integrated software applications for sequencing, resequencing (mutational profiling), and fragment analysis streamline and automate data collection, analysis, and reporting. And with the Automated Polymer Delivery System, you get simple, speedy set-up, minimal maintenance requirements, plus a full complement of walkaway automation features that allow you to spend less time running samples and more time advancing your research.

Enhanced data quality, more successful samples per day.
The advanced, proven optics of the 3130 Series provides an extremely high signal-to-noise ratio and a uniform cross-array signal profile. The superior sensitivity and precision also improve your success rate across a wide range of sample template types and concentrations—minimizing failed sequences and maximizing your lab's throughput. And unlike slab-gel systems, you need only minimal amounts of DNA for accurate analysis.

Complete system for multiple applications.
The Applied Biosystems 3130 Series Genetic Analyzers are part of our complete, integrated solution for sequencing and fragment analysis applications. Both systems—the upgradable 4-capillary 3130 Analyzer and the 16-capillary 3130*xl* Analyzer—offer easy conversion between applications with minimal user intervention.

You can run a wide variety of CE applications —including microsatellite analysis, AFLP, LOH, SNP validation, and SNP screening— as well as *de novo* sequencing and resequencing (mutational profiling). The full range of applications can be run on a single polymer and capillary array, or you can optimize run conditions further, if necessary, by using additional array lengths and run conditions.

Robust downstream software.
Optimized for Applied Biosystems chemistries and instruments, powerful application-specific downstream software minimizes troubleshooting with quality values, and simplifies data analysis and reporting.

Commitment to excellence—and to your success.
Applied Biosystems is a pioneer in the design and manufacture of complete, automated life science systems that help you meet your research goals. Applied Biosystems customers also benefit from our many years and expertise in DNA analysis, our widespread industry presence, and our extensive customer network. The Applied Biosystems technical support staff solves problems ranging from simple operations to complex differential chemistries and is always available to help you with your research.

References

Beale, Stephen C. 1998. Capillary Electrophoresis. *Anal. Chem.* 70:279R–300R.

Kuhr, Werner G. and Monnig, Curtis A. 1992. Capillary Electrophoresis. *Anal. Chem.* 64:389R–406R.

Landers, J. P., Ed. 1997. *Handbook of Capillary Electrophoresis, 2nd ed.;* Boca Raton: CRC Press.

Lazaruk, K., Walsh, P. S., Oaks, F., et al. 1998. Genotyping of Forensic STR Systems Based on Sizing Precision in a Capillary Electrophoresis Instrument. *Electrophoresis* 19:86–93.

Madabhushi, R. S. 1998. Separation of 4-Color DNA Sequencing Extension Products in Noncovalently Coated Capillaries Using Low-Viscosity Polymer Solutions. *Electrophoresis* 19:224–230.

Monnig, Curtis A., and Kennedy, Robert T. 1994. Capillary Electrophoresis. *Anal. Chem.* 66:280R–314R.

Nakatani, M., Shibukawa, A., Terumichi, N. 1995. Chemical Stability of Polyacrylamide-Coating on Fused Silica Capillary. *Electrophoresis* 16:1451–1456.

O'Neill, M. D. 1995. Sequencers Benefit from Solid-State Detectors. *Laser Focus World* 31(10):135–142.

Rosenblum, B. R., Oaks, F., Menchen, S., Johnson, B. 1997. Improved Single Strand DNA Sizing Accuracy in Capillary Electrophoresis. *Nucleic Acids Res.* 25(19):3925–3929.

St. Claire, Robert L. III. 1996. Capillary Electrophoresis. *Anal. Chem.* 65:569R–586R.

Sizing of DNA Fragments by Capillary Electrophoresis. 1994. Application Note, Applied Biosystems.

Sweedle, J. V., Shear, J. B., Fishman, H. A., et al. 1991. Fluorescence Detection in Capillary Zone Electrophoresis Using a Charge-Coupled Device with Time-Delayed Integration. *Anal. Chem.* 63:496–502.

Wenz, H. M., Robertson, J. R., Menchen, S., et al. 1998. High-Precision Genotyping by Denaturing Capillary Electrophoresis. *Genome Research* 8(1):69–80.

Wenz, H. M. and Wiktorowicz, J. E. 1997. *Gene Analysis and Nucleic Acid Sequencing.* In: Handbook of Capillary Electrophoresis Applications; Eds. H. Shintani and J. Polonsky. London: Blackie Academic & Professionals.

Zhang, J. Z., Fang, Y., Hou, J. Y., et al. 1995. Use of Non-Cross-Linked Polyacrylamide for Four-Color DNA Sequencing by Capillary Electrophoresis Separation of Fragments up to 640 Bases in Length in Two Hours. *Anal. Chem.* 67:4589–4593.

iScience. To better understand the complex interaction of biological systems, life scientists are developing revolutionary approaches to discovery that unite technology, informatics, and traditional laboratory research. In partnership with our customers, Applied Biosystems provides the innovative products, services, and knowledge resources that make this new, **Integrated Science** possible.

Worldwide Sales Offices
Applied Biosystems vast distribution and service network, composed of highly trained support and applications personnel, reaches 150 countries on six continents. For international office locations, please call the division headquarters or refer to our Web site at **www.appliedbiosystems.com**

Applera is committed to providing the world's leading technology and information for life scientists. Applera Corporation consists of the Applied Biosystems and Celera Genomics businesses.

Headquarters
850 Lincoln Centre Drive
Foster City, CA 94404 USA
Phone: 650.638.5800
Toll Free: 800.345.5224
Fax: 650.638.5884

For Research Use Only.
Not for use in diagnostic procedures.

Printed in the USA, 05/05
Publication 106MI60-01

Applied Biosystems