![asdqms]

Statistical Process Control

SPC Data Collection & Analysis

by David A. Berger

Using a Foot Switch (#300-50) to trigger a reading from one to all ports simultaneously – ideal for gage fixtures.

RS-232 Connector to PC

ASDQMS' Mission Statement

Our mission is to assist customers with improving the quality of their products by providing the best possible SPC (Statistical Process Control) solutions. We continually exceed our customers' expectations by taking the lead in building state-of-the-art SPC gage interfaces, data collection systems and analysis software.

We support increased quality and productivity in the manufacturing processes and engineering design. By using our SPC interfaces, software and Design of Experiments, the manufacturing community competes more effectively in world markets.

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SOFTWARE

GAGE INTERFACES

PORTABLE ROVING DATA COLLECTORS

PART NUMBERS

SPC1+ Software Summary

Software Comparison:

- **SPC1+ Navigator:** spreadsheet package designed primarily for off-line SPC/SQC analysis
- **SPC1+ Enterprise:** database package designed for real-time SPC data collection and analysis
- **SPC1+ Internet:** reporting and data analysis via the Web
- **SPC1+ ActiveX:** integrates SPC functions with existing software applications

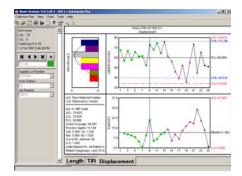|	SPC1+ **Navigator**	SPC1+ **Enterprise**	SPC1+ **Internet**	SPC1+ **ActiveX**
Variable Data Analysis				
Individual X/Moving Range	✓	✓	✓	✓
X-bar/Range	✓	✓	✓	✓
X-bar/Sigma	✓	✓	✓	✓
Histogram	✓	✓	✓	✓
Capability Analysis	✓	✓	✓	✓
Moving Average	✓	✓		✓
Moving Range	✓	✓		✓
Moving Sigma	✓	✓		✓
CuSum	✓			
EWMA	✓			
Multivariate Control Charts	✓			
Autocorrelation Function	✓			
Gage Repeatability & Reproducibility				
Gage Bias (Accuracy)	✓			✓
Gage Performance	✓			✓
Gage Linearity & Stability	✓			✓
Attribute Data Analysis				
P, Np, C and U Charts	✓	✓	✓	✓
General Data Analysis				
Run Charts	✓	✓	✓	✓
Pareto	✓	✓		✓
Regression (Scatter Diagram)	✓	✓		✓
Short Run Analysis	✓			
Process Monitor Chart		✓		
Box-Whisker Chart		✓		
Bar & Pie Charts		✓		
Portable Roving Data Collector				
Genesis 1000 Series	✓	✓	✓	
Gage Interfaces				
SmartCable, GageMux & MGI	✓	✓	✓	

SPC1+ Enterprise

Shop-floor Data Collection and Analysis Software Made Easy

- User-friendly centralized administrator tools
- Real-time data collection through gages and most measuring devices
- Stores SPC information in a Microsoft Access or SQL database
- Import shop-floor roving data

From a central location, users employ the Desktop Explorer screen to create and modify Worksets, monitor all data collection processes, manage the database and generate reports. The Workset screen uses predefined profiles based on each operator's preset log-on preferences. The system automatically creates a date and time stamp, performs data validation and traceability while also identifying problems and suggesting corrective actions. A straightforward program wizard guides operators through the process of configuring the collection of data.

Stay on top of problems with instant notification…

When defined parameters become out of control, selected users receive automatic notification.
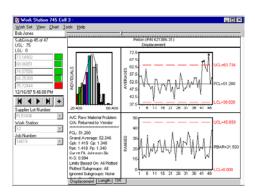

Charts & Analyses

- X-bar range/sigma
- Run, C, U, Np, P
- Process monitoring
- Process capability
- Box-whisker
- Pareto, bar & pie
- Scatter diagrams

Now Available…

- SPC1+ Enterprise Professional Edition (offering advanced analysis, remote monitoring and built-in report writer)

SPC1+ Navigator

Advanced Analysis and Data Collection Software

SPC1+ Navigator allows engineers and managers to…

- Import roving data and automatically collect shop-floor data
- Analyze complex control charts from Excel data files
- Provide real-time open access across multiple platforms (using Microsoft's ODBC)
- Enter data into a spreadsheet with definable calculation parameters

Charting and reporting made easy…

- One-click Web publishing permits authorized users to access data anytime, anywhere
- Embed data in word processing files (such as MS WORD) to produce detailed reports
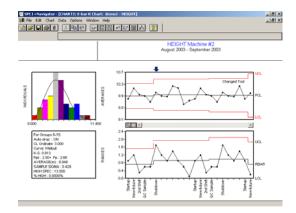- Annotate reports directly to highlight problem areas in the manufacturing process
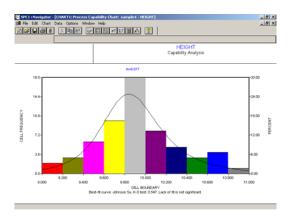
SPC analysis special features include…

- Charts: data variables and attributes
- Gages: measurement systems analysis
- Flowcharts: cause and effect module

Enhanced SPC tools, including…

- Advanced analysis
- Gage R&R
- DOE
- Cusum
- EWMA

- Autocorrelation
- Scatter diagram
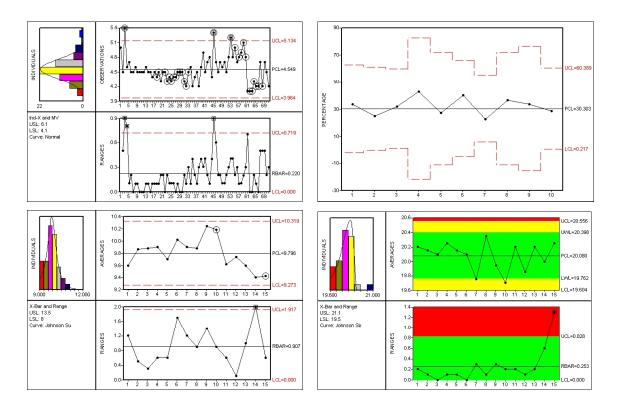- Run Charts
- Linearity
- Multivariate control charts

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SPC1+ ActiveX Control

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SPC ActiveX Control for Programmers

Customize SPC applications and integrate data collection

Our SPC1+ ActiveX control allows software development teams to customize applications using a drag-and-drop SPC analysis capabilities package. Dropping in the ActiveX control adds sophisticated control charting and statistical analysis to popular software applications, allowing users to maintain full control over user interface, data acquisition and management. Runtime is not included with developer's license.

SPC1+ ActiveX runs transparently within software without launching any separate applications that require manual data manipulation

SPC1+ ActiveX features include the following variable and attribute analytical tools:

- X-bar/range/sigma
- Individual X/moving range/run chart
- Process capability/histograms
- Moving average and range/sigma charts

- Simple linear regression chart
- Attributes charts (P, U, Np, C)
- Scatter Diagrams
- Gage repeatability and reproducibility

SPC1+ Internet

Share SPC data via the Web

Share SPC data with customers, suppliers and field reps…

- Security controls for defining individual user access

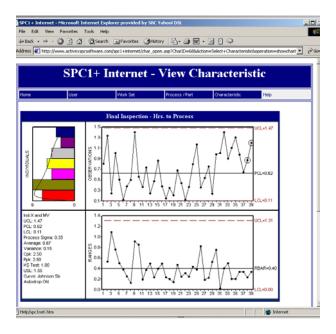### Web server updating is simple and fast. Data are…

- Read from SPC1+ Navigator running on a LAN or workstation
- Imported using open source code or ODBC compliant software
- Collected at selectable intervals and access points

Users can define…

- Charts: type and size
- Queries: subgroup or date-range
- Limits: statistically calculated or user-specified

Customize display screens…

- Add company logos
- Tailor data entry forms
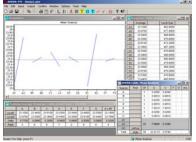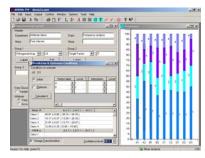- Specify priority of drawings

ANOVA-TM®

Design of Experiments: The Taguchi Method

ANOVA-TM® for Windows is based on the methods developed by Dr. Genichi Taguchi. This indispensable software is an orderly and methodical process for systematically assessing experimental results (when a variety of factors dynamically effect a specific quality characteristic). ANOVA-TM® employs an easy-to-use Windows graphical user interface.

ANOVA-TM will help…

- Maximize output and quality while minimizing product cost
- Reduce output variability and process sensitivity to noise factors
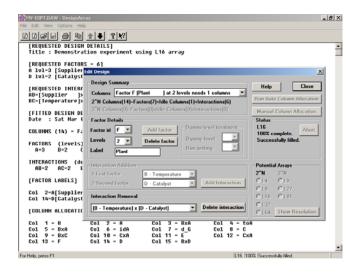
Features include…

- 32-bit application—compatible with MS Windows operating systems
- New configuration features: turn on or off warning messages, signal-to-noise (s/n) formulas, etc.
- Reset array option when editing an orthogonal array
- Updated dynamic characteristic calculations in accordance with ASI
- S/n data table for dynamic characteristics with new columns to represent intermediate calculations for compounded and non-compounded signal factors
- Response and s/n ratio window titles now show total mean average, total s/n average and total slope average respectively
- New dialog for Anova table to facilitate pooling of factors
- Response graph window title includes the analysis type, useful in dual graph mode
- Two new workbook examples for dynamic characteristics from the *ASI Robust Design Manual*
- Individual orthogonal array files and 4-way analysis of an orthogonal array or single factor (orthogonal arrays up to L108 in size)
- Decomposition of factors to unit degree of freedom, computation of interactions between factors, and use of s/n, sensitivity analysis, and omega transformation in calculations
- Dual graphs for raw versus s/n and s/n versus sensitivity as well as user-defined s/n ratio editor
- Auto pooling on V, F, and Rho% (plus un-pooling functions)
- Display and print-level sums, level averages, and process averages
- Graphics capabilities for level average response tables (a line graph for variable data and a histogram for attribute data)
- Capability of generating data-collecting forms on which to set up experiments

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ANOVA-TM® Professional

With just a mouse click or keystroke, ANOVA-TM® Professional for Windows delivers crisp, clean, full-color screens allowing users to choose and highlight precisely what they wish to view.

Highlights…

- Enhanced Help menu
- Rapid navigation—select files, experiments and tables via icons, tool bar buttons and menus
- Custom screens—mix and match, overlay, tile and cascade multiple windows. Display a single experimental layout, data spreadsheet and graph
- Share data—ANOVA-TM Professional's spreadsheets can be copied and pasted with ease

Design Array…

- Automatically selects the appropriate array, allocates factors and interactions to columns and modifies the array to allow for multi-level factors
- Creates powerful designs using intuitive layout and on-line documentation help
- Eliminates leafing through pages of linear graphs and modifying them to create the right design
- Avoids transcription errors when creating multi-level factors
- Allows user to enter the number of levels for each factor, the interactions to be studied and nominate the columns

Features include…

- Graphs for level average response tables
- Histograms for attribute data
- Decomposition of factors to unit degree of freedom
- Use of signal-to-noise sensitivity analysis and omega transformation in calculations
- Extended capabilities for dual display of raw data and signal-to-noise and sensitivity from nominal to best
- ANOVA table identifies and analyzes degrees of freedom, sum of squares, variance, percent contribution for factors and interactions or their decompositions
- Generation of optimum experimental conditions including repeating the process up to 100 interactions or until the optimum condition occurs
- Automatic filling of the orthogonal array allows users to produce designs quickly
- Optional manual filling of the orthogonal array gives users complete control over array design
- Supports interactions between factors

SmartCable™

The SmartCable™ line of single input gage interfaces converts the output of any manufacturer's gage into standard RS232 or Mitutoyo output format for use in any SPC data collection system.

The SmartCable™ quickly configures itself through simple DIP switches (or host commands). ASDQMS has made it easy to connect calipers, micrometers, indicators or any other gages directly to PCs or Mitutoyo compatible devices. Readings are triggered using the gage's send button, an external foot switch (connected via external foot-switch jack) or host request. The SmartCable's interface is designed with the harsh shop-floor environment in mind and employs an advanced micro-controller.

The SmartCable™ adds functionality to virtually any existing gage by allowing data collection in either static mode (instantaneous reading) or dynamic mode (MIN/MAX/TIR). Requiring no external power supply, the SmartCable™ gets its power via the PC's serial port or Mitutoyo compatible systems, making it ideal for portable (roving) data collection (optional 9 VDC external power supply is available).

SmartCable™ easily connects devices to PC via...

- Standard RS232 ASCII port
- Mitutoyo DP1, DP3, DP7 and Mux 10
- Mitutoyo Digimatic compatible devices

It's portable just 1 ½" x 4 ¼" x 1"

Special features…

- Simple plug and play set up—doesn't require software configuration
- Operating modes: Static (Normal) mode operation or Dynamic (MIN / MAX / TIR)
- Footswitch input, LED status light, host command operation and set up
- Low power (draws power from the PC or most Mitutoyo devices)

Output specifications…

RS232 Output: 9600, 8, N, 1. ASCII text string in three formats—reading only, full output or Mitutoyo

Example output data…

+1.004<CR><LF>

001,   +2.4321, NRM, 01<CR><LF>

01A +1.2345<CR>

GageMux® & Micro GageMux®

The GageMux® is the newest addition to ASDQMS' line of universal interfaces

Before the invention of the GageMux®, inspectors either checked the quality of components by hand, writing the results on a clipboard or trundled a cumbersome computer across the shop floor. ASDQMS' GageMux® has revolutionized data collection and storage. By converting analog or digital input into a standard serial ASCII RS232 or Mitutoyo signal, it allows users to connect hundreds of different types of measuring devices and gages to an automated data collection system such as a hand-held computer.

The GageMux® supports 2, 4 or 8 inputs (daisy-chaining up to 64 gages) and reads directly from Mitutoyo compatible gages including…

- MTI digimatic output gages
- Mahr Federal uMaxum
- CDI Logic
- Starrett Wisdom
- Chatillon DFIS
- Fowler Ultra Logic
- Mahr Federal Maxum and Dimension Air gages

Using a Foot Switch (#300-50) to trigger a reading from one to all ports simultaneously – ideal for gage fixtures.

Using a Backplane Cable (#300-47) to connect multiple GgeMux's.

Special features…

- Simple Plug and Play set up—doesn't require internal switch settings or software configuration
- Operating modes: Static (Normal) mode operation or Dynamic (MIN/MAX/TIR)
- Footswitch input, LED status light, host command operation and set up
- Low power (draws power from the PC and most Mitutoyo devices)

Output specifications…

RS232 Output: 9600, 8, N, 1. ASCII text string in three formats—reading only, full output or Mitutoyo output string

Example output data…

+1.004<CR><LF>

001,   +2.4321, NRM, 01<CR><LF>

01A +1.2345<CR>

Now Available…

Micro GageMux® a lightweight and portable gage interface measuring just 2 ½" wide by 3" deep by ½" high. Weighing in at just over an once, it supports 2 inputs and requires no external power supply, making it ideal for portable roving collectors.

Genesis Multi-gage Interface (MGI)

The Genesis Multi-gage Interface (MGI) streamlines data collection process.

Users collect data from a wide range of electronic gages and convert the signals to a common RS232 output. Measured data goes directly to PCs for use with statistical process control software.

Genesis MGIs have four gage ports and can be daisy-chained to increase the number of ports at any one gaging station. In addition, a bayonet connector provides convenient foot-switch operation when needed. Up to 32 gages can be interfaced to a single PC serial port in any analog or digital combination. The MGI is available in two models…

- Genesis MGI-D (digital) with 4 digital ports
- Genesis MGI-C (combined) with 2 digital and 2 analog ports

Automatic Gage Recognition (AGR)…

- True plug and play
- Automatically recognizes the gage and applies proper communications routines
- No user set up is required
- Uses low-cost gage cables

The MGI interfaces with hundreds of gages from a wide variety of manufacturers including…

- Micrometers
- Height, thickness and laser gages
- Hardness testers
- Calipers
- Weight scales
- Torque wrenches
- Surface analyzers
- Indicators
- Comparator displays

Analog gage ports provide excellent resolution through a 12-bit (plus sign) A/D converter. Data from a column gage with a full-scale resolution of ± .010 will resolve to 2.5 millionths of an inch. The MGI with analog capabilities also provides…

- Reference voltages to drive variable resistance or strain gage devices
- Easy configuration of gage signals to MGI requirements with ASDQMS interface cables
- Inputs configured for single ended, dual or differential operation
- "First Peak" and "Total Peak" readings from analog inputs (useful in torque applications)

Interfaced to a PC, MGIs provide direct gage input for a PC inspection station. They can also be used in conjunction with Genesis data collectors to provide additional gage ports. Aside from simple gage readings, the MGI offers…

- Continuous gage reads (as long as the footswitch is depressed) with MIN, MAX, TIR and continuous average output capability
- Sequential readings of multiple gages (ideal for gage fixture applications)
- Parametric selection using a specific measured value or several values from a multiple parameter gage (e.g., comparator with multiple axis display, force gage with MIN and MAX readings, etc.)
- The MGI can be used at a fixed station, operating on an AC adapter/charger

ASDQMS offers a number of statistical software packages to support data collection and analysis. Operating on Windows based PCs, ASDQMS offers the Wedge, SPC1+ Enterprise and SPC1+ Navigator software.

Software I/O specifications are also available for interfacing the MGI's direct gage input to individual software packages.

Analog…

- Input voltage: $\pm$ 5 mV minimum
- Resolution: $\pm$ 4000 counts at $\pm$ full scale voltage
- Excitation voltage: +2500mV $\pm$ 5 mV at 0-80 mA, -2500 mV $\pm$ at 0-80 mA

Output to status and control devices port…

- Connect external accessories including earphones and status lights or control signals

Optional Power…

- Internal rechargeable NiCad batteries or external AC charger/adapter (12-14 hours usage)

Dimensions…

- 9 ¾" x 8 ½" x 2"

Gage Interface Comparison Guide

Choose the right gage interface to meet every need

	Footprint	Inputs Support	Power	Operating Modes	Expandability
SmartCable	▪ 1 ½" W ▪ 4 ¼" D ▪ 1" H	▪ 300 gage types	▪ PC RS232, or MTI compatible system (external power supply optional)	▪ Static (normal), dynamic (max, min or TIR) mode	▪ Single input
Micro GageMux	▪ 2 ½" W ▪ 3" D ▪ ½" H	▪ MTI ▪ Digimatic ▪ Federal ▪ Maxum ▪ uMaxum ▪ CDI Logic ▪ All others using SmartCable	▪ PC RS232, or MTI compatible system (external power supply optional)	▪ Static (normal), dynamic (max, min or TIR) mode	▪ Two input
GageMux	▪ 5 ½" W ▪ 4 ¼" D ▪ 1" H	▪ MTI ▪ Digimatic ▪ Federal ▪ Maxum ▪ uMaxum ▪ CDI Logic ▪ All others using SmartCable	▪ External 9 VDC 2.5 mm outer pin negative power supply	▪ Static (normal), dynamic (max, min or TIR) mode	▪ Mix and Match 2, 4 or 8 input models using the daisy-chain back plane cable for 64 gages to one RS232 port
MGI	▪ 9 ¾" W ▪ 8 ½" D ▪ 2" H	▪ 1,000s of digital and analog gages	▪ External AC charger/adapter or optional internal rechargeable NiCad batteries (12-14 hours usage)	▪ Static (normal), dynamic (max, min or TIR), continuous average output, sequential reads, parametric selection of values from multiple parameters	▪ Mix and Match 4 digital or 2 digital and 2 analog models using the daisy chain cable for 32 gages to one RS232 port

Genesis Roving Data Collectors

Handheld SPC data collectors

The Genesis line of roving data collectors gathers up to 32 variables and/or attributes. Depending on the model, users may collect data from analog, digital, LVDT, bar code or voice recognition devices. And with Genesis' automatic gage recognition, there is no need to program in gage information—just plug in any gage and collect data.

Trend analysis…

- Automatically warns of out-of-control situations through status lights and screen displays, prompting users with causes and corrective actions using eight user-defined tests

Traceability…

- Choose from up to 8 user-defined subgroup variables (date, time, operator, machine number, etc.)
- built-in capability to filter data based on any combination of subgroup variables

Capacity…

- Collects data on as many as 99 features per part
- Each unit can handle subgroup sizes from 1 to 50
- Capacity to store and analyze 24,000 measurements
- All models are "variable" data collectors, but models QA3000 and QA3300 also perform input of "attribute" data within the same part program as well as Gage R&R

Functionality…

- Hand-held (portable and self-contained)
- Fixed station with optional external monitors
- Networks with enterprise systems

High-contrast LCD screen displays crystal-clear charts, graphs and data lists…

- 16-line by 42-character super-twist LCD displays more information than other portable collectors
- Pop-up window warn users when process is out of control and recommend courses of action

Annual maintenance agreements include the following…

- Free firmware and software upgrades
- Attractive trade-in programs

Instant access to data…

- Point and select feature allows users to point to a specific subgroup or feature on the display
- With a single keystroke, users access measured data, subgroup variables, statistical calculations

Status lights…

- Complete array of status lights to advise operator of conditions requiring immediate action

Fully sealed keyboard and keypad…

- Functional sealed QWERTY keyboard and numeric keypad

Built-in network hardware…

- RS485 output for direct communication to any network
- Optional LAN-link module for 10baseT Ethernet networks

Output to status and control devices port…

- Connect external accessories including earphones and status lights or control signals

Print hard-copy reports…

- Centronics parallel port for printing charts and data reports, including x-bar/r, x-bar/s, ix/mr, mx-bar/mr, histogram, pareto, capability, sample and subgroup data, mean, standard deviation, C_p, C_{pk}, P_p, P_{pk}, CR, PR, C_{pm}, CP_U, CP_L, Z_U, Z_L, % US, % OS, skewness and kurtosis

Genesis QA 2500 and 2800 summary…

- QA2500 incorporates 4 digital gage ports
- QA2800 incorporates 2 digital and 2 analog gage ports
- Additional gages may be interfaced by adding Genesis Multi-gage Interfaces (MGIs)

QA3000 and 3300 summary…

- QA3000 unit incorporates 4 digital gage ports
- QA3300 incorporates 2 digital and 2 analog gage ports
- Additional gages may be interfaced by adding Genesis Multi-gage Interfaces (MGIs)
- Variables data collection and analysis with the flexibility to collect and analyze attribute data
- Gage R&R

Why Gage R&R (Repeatability and Reproducibility) is so important…

- An analysis of a process cannot be meaningful unless the gages used to collect data are both accurate and repeatable
- Without fully understanding the performance of the gaging used to produce this data, users may be reacting to faulty gages rather than variations in the process itself
- Firms pursuing ISO 9000 need Gage R&R as it is an important asset

Size and weight…

- 9 ¼" x 8 ½" x 3 ¼" at 4 lbs

Battery life is 12-14 hours (continuous use)

Genesis QA Series Comparison Guide

	QA2500	QA2800	QA3000	QA3300
Operating Modes				
Attribute	*	*	*	✔
Variable	✔	✔	✔	✔
Gage Capability				
Digital	✔	✔	✔	✔
Analog	**	✔	**	✔

* Limited attribute input is available within the variables part program

** While these models have no integrated port for analog gages, they are capable of accepting analog input through Genesis MGIs with analog capability

Part Number Guide

Part Number	Description
SPC-ENT-1	SPC1+ Enterprise
SPC-PRO-1	SPC1+ Enterprise Professional
SPC-NAV-1	SPC1+ Navigator
SPC-ACX-D5	SPC1+ ActiveX Control 5-user developer licenses (no Runtime license)
SPC-ACX-U1	SPC1+ ActiveX Control 1-user Runtime license
SPC-INT-10	SPC1+ Internet 10-user license
20-030	ANOVA-TM
20-240	ANOVA-TM site license
20-035	ANOVA-TM Professional
20-245	ANOVA-TM Professional site license
200-50R	SmartCable – Mitutoyo to RS232 output (all Digimatic gages require gage cable)
200-22M	SmartCable – Generic RS232 to Mitutoyo output
100-20P-F	GageMux® 2-port – includes PC cable and power supply
100-40P-F	GageMux® 4-port – includes PC cable and power supply
100-80P-F	GageMux® 8-port – includes PC cable and power supply
100-20SC	Micro-GageMux®
159280-11	MGI-D – 4 digital ports
159500	MGI-C – 2 digital and 2 analog ports
159314	MGI/PC cable – 25 pin
159315	MGI/PC cable – 9 pin
159231	DC Charger – 120 VAC
159277	DC Charger – 220 VAC
159510-11, 21*	QA2800
159290-31, 41*	QA3000
159510-31, 41*	QA3300, QA2500SR, QA3000SR
159848-11, 21*	QA3300, QA2500SR, QA3000SR
159848-31, 41*	QA3300, QA2500SR, QA3000SR

* suffixes 11 and 31 operate at 110 VAC
* suffixes 21 and 41 operate at 220 VAC

NOTE: All Genesis data collectors include manual 159016 and AC adapter/charger 159231