



A SCENT OF FUTURE

Master GC

FAST GAS CHROMATOGRAPH

HIGH PRODUCTIVITY

ACCURACY AND PRECISION

FLEXIBILITY AND UPGRADEABILITY

USER FRIENDLY INTERFACE





Master
Master GC
FAST GAS CHROMATOGRAPH

A Breakthrough in Fast GC Performance

Nowadays, the enormous growth of the number of samples to be analyzed per day is challenging the laboratories worldwide. Hence, the more stringent analytical requirements demand to speed up the gas chromatographic analyses.

Fast GC is the most valuable analytical approach to address modern laboratories' demands to significantly enhance sample throughput, while reducing operational costs per sample and obtaining the results in an attractive shorter time.

The MASTER GC delivers unsurpassed analytical capabilities meeting today's laboratories productivity requirements. The versatile and flexible MASTER GC is uniquely designed to perform conventional and fast gas chromatographic analyses fulfilling the demands of routine and research analyses over a variety of industries and applications such as environmental, agriculture, food and beverage, flavor and fragrance, petrochemical, and pharmaceuticals among others.

The system can be equipped with an array of inlet systems and a wide selection of detectors, suitable for conventional and Fast GC analyses. The system integrates leading-edge technology with total system control delivering outstanding reliability, repeatability, and performance.

In combination with the MASTER AS Liquid Autosampler, the MASTER GC offers complete automation of all operation steps, providing increased sample throughput and optimized vial processing to achieve maximum system productivity. The analytical precision is further increased through an extremely flexible handling of standard solutions.

A touchscreen display permits the total control of the MASTER GC and MASTER AS, providing also the quick and easy set up of all operating parameters. Moreover, the system can be fully controlled by the simple and effective Clarity™ Chromatography Station, starting from sampling to acquisition, data processing, and reporting.

HIGH PRODUCTIVITY

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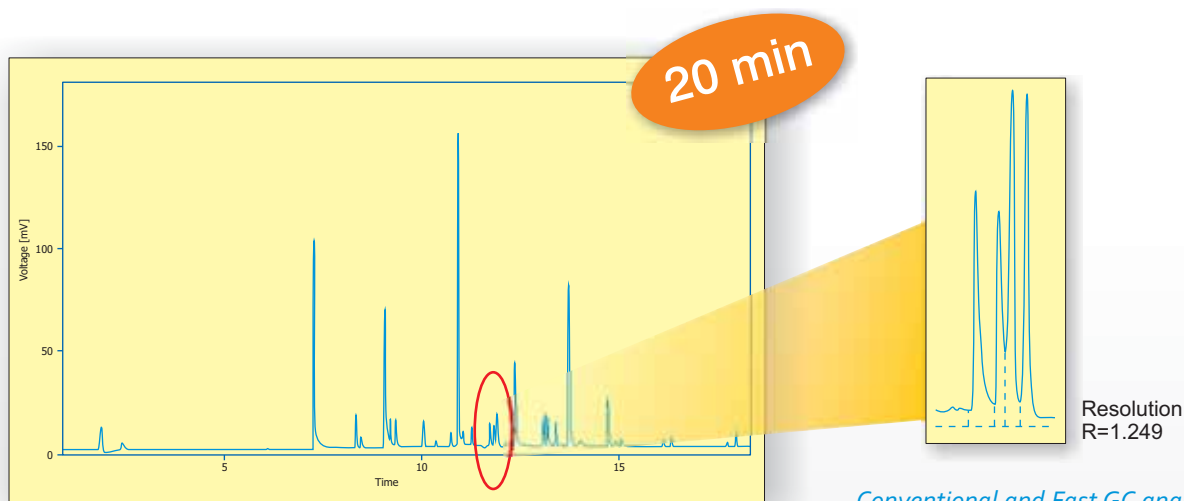
Master

High Productivity

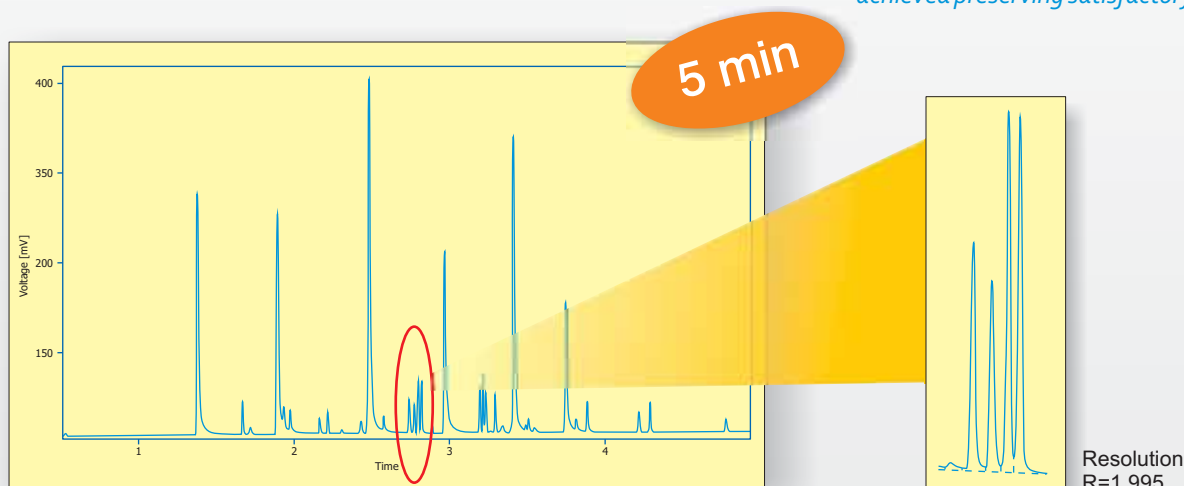
Productivity is, obviously, fundamental for laboratories with a high daily sample throughput. Therefore, the main goals to achieve productivity are: faster analysis run times and higher performance, thus, significantly reducing laboratory operating costs.

The use of automated instrumentation and Fast GC methods are the right approach for modern laboratories to enhance their productivity, not only reducing the run times but also maintaining analytical accuracy and precision unaffected.

The primary goal of Fast GC is to maintain proper resolving power in shorter analysis run times by using adequate instrumentation and analytical columns in combination with optimized method parameters. Analysis time can be drastically reduced by using shorter analytical columns with narrower internal diameter and thinner stationary phase films, higher carrier gas linear velocities, faster oven temperature programming and cooling rates. The MASTER GC features a maximum heating rate of up to 140 °C/min and a typical cooling time of 4 min. The system, equipped with narrow bore Fast GC columns of 50-100 mm I.D., permits shorter analysis times to be achieved without compromising chromatographic resolution.

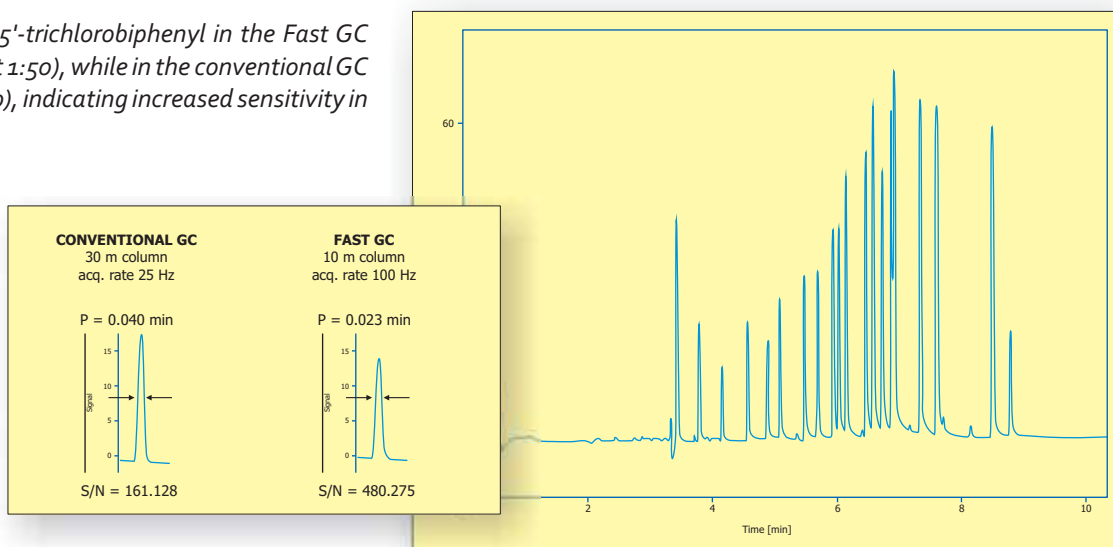


Conventional and Fast GC analyses of a 20 PCB congeners mixture. In Fast GC significant analysis time reduction is achieved preserving satisfactory resolution.



In addition to improved efficiency, narrow bore columns combined with faster GC oven temperature programming generate sharper peaks with typical peak widths of 0.5 seconds or less. Sharper peaks result in higher signals and greater signal-to-noise ratios, therefore increasing sensitivity.

The signal-to-noise ratio of 2,2',5'-trichlorobiphenyl in the Fast GC application is about 480.275 (split 1:50), while in the conventional GC application it is 161.128 (split 1:10), indicating increased sensitivity in Fast GC.



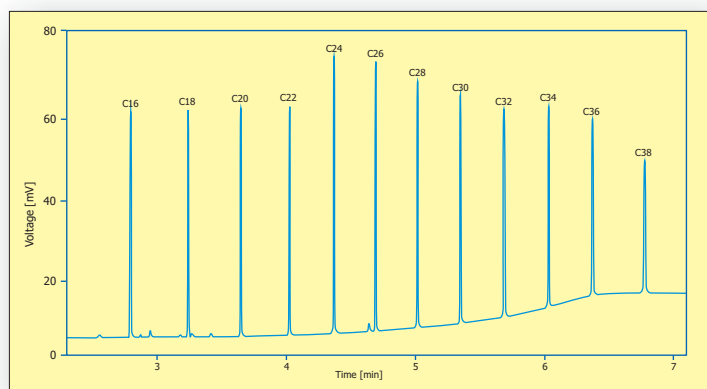
Unlike Ultrafast GC systems, which are equipped with a dedicated and expensive column device, the MASTER GC can be operated in Fast GC without any hardware modification and hence keeping column integrity unaffected.

The MASTER GC can be combined to a wide range of autosamplers. When the MASTER GC is equipped with the MASTERAS, complete automation of all operation steps is delivered, including standard addition. Up to 160 samples can be run sequentially and unattended with enhanced sampling precision and accuracy, providing increased sample throughput.

Accuracy and Precision

Unparalleled chromatographic accuracy and precision are guaranteed by the patented Digital Flow Control (DFC). The DFC, along with the optimal control of the oven temperature, assures outstanding retention time repeatability, unprecedented for all chromatographic measurements. The DFC allows the MASTER GC to be operated in five different modes: constant or programmed flow, constant or programmed pressure, or constant linear velocity. The pulsed injection mode is also available, allowing improved sample transfer into the analytical column, and therefore enhanced sensitivity and repeatability.

Furthermore, the DFC automatically adjusts the carrier gas flow to compensate for ambient temperature and pressure, providing constant retention times and enhanced repeatability and robustness.



	C16		C28	
	T_R (min)	SD	T_R (min)	SD
Conventional GC	7.934	0.0006	18.4721	0.0009
Fast GC	2.1896	0.0005	5.549	0.0009

Fast GC chromatogram of a hydrocarbon series ranging from C16 to C38. Excellent retention time repeatability is assured by the patented DFC in Fast and conventional GC analyses.

Flexibility and Upgradeability

The advanced modular design of the MASTER GC components features outstanding flexibility and upgradeability. Any GC configuration can be easily modified or upgraded.

The MASTER GC allows the easy assembly of a complete range of injectors, including Split/Splitless (SL/IN), Programmable Temperature Vaporizer (PTV), and Packed (PK) injectors. Up to three injection systems can be installed simultaneously.

Split/Splitless Injector - SL/IN

The most popular GC injector features an outstanding design and thanks to the patented DFC provides excellent precision in split, splitless, and pulsed injection modes of operation. In addition, the post-injection carrier gas save mode is a valuable cost saving feature. To fulfill the users' analytical needs a series of liner types are available, including liners suitable for SPME analysis.

Packed Injector - PK

The sample can be directly introduced into packed or wide bore columns. A flexible injector for affordable solutions.

Programmable Temperature Vaporizer - PTV

The proprietary PTV is particularly suggested when high sample integrity is requested. The sample is introduced by cold injection followed by vaporization eliminating possible sample discrimination or degradation.

The PTV achieves extremely fast heating rates of up to 1,000°C/min and rapid cool down with ambient air. Cryogenic cooling options using either CO₂ or N₂ are also available for highly specific applications.

After injection, the PTV can be programmed to decrease the split flow and save carrier gas. Moreover, the DFC adjusts the carrier gas flow providing ambient temperature and pressure compensation. In addition, the injector septum is purged by a constant flow to avoid carry-over effects.

The versatile PTV injector is Fast GC compatible and supports up to four injection techniques: split, splitless, solvent split, or pulsed injection. Moreover, the dimensions of the standard PTV liner are ideal for direct SPME fiber introduction and desorption, taking advantage of the injectors performance characteristics.

For specific applications requiring pre-concentration or refocusing of gaseous samples, liners filled with sorbent materials are also available.



The MASTER GC also features a wide selection of detectors compatible with Fast GC applications, such as Flame Ionization Detector (FID), Electron Capture Detector (ECD), Nitrogen-Phosphorus Detector (NPD), Flame Photometric Detector (FPD), and the MASTER TOF-MS Time of Flight Mass Spectrometer. Further detection systems dedicated to conventional analyses are: Photo Ionization Detector (PID), Thermal Conductivity Detector (TCD), Micro TCD (μ TCD), and Pulsed Discharged Detector (PDD).

The possibility to simultaneously use up to three detectors delivers exceptional flexibility and expands the system capabilities.

Fast Detectors

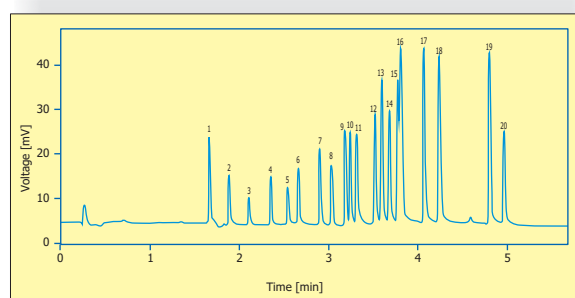
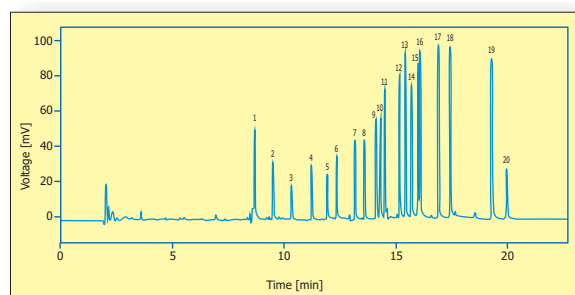
Fast GC analysis requires rapid detection systems to handle the very narrow peaks, with a typical peak width of 0.5 seconds or less, which are generated during each run. DANI offers a variety of detectors engineered to handle sharp peaks with fast electronics. All detectors perform data acquisition rates of up to 300 Hz providing satisfactory information for correct peak reconstruction, and therefore the reliable detection of sharp peaks. You can find the most appropriate detection system for each sample.

FID - Flame Ionization Detector

The most used GC detection system measures the ions produced by organic compounds during combustion. It is extremely sensitive with a wide dynamic range of seven orders of magnitude.

ECD - Electron Capture Detector

The first option for environmental measurements, offers excellent performance in the determination of PCBs, pesticides, and other halogenated organic compounds.



- | |
|--|
| 1) 2,4,5,6-tetrachloro-m-xylene (S,S) |
| 2) 2,3-dichlorobiphenyl |
| 3) 2,2',5'-trichlorobiphenyl |
| 4) 2,4',5-trichlorobiphenyl |
| 5) 2,2',5,5'-tetrachlorobiphenyl |
| 6) 2,2',3,5'-tetrachlorobiphenyl |
| 7) 2,3',4,4'-tetrachlorobiphenyl |
| 8) 2,2',4,5,5'-pentachlorobiphenyl |
| 9) 2,2',3,4,5'-pentachlorobiphenyl |
| 10) 2,3,3',4',6-pentachlorobiphenyl |
| 11) 2,2',3,5,5',6-hexachlorobiphenyl |
| 12) 2,2',4,4',5,5'-hexachlorobiphenyl |
| 13) 2,2',3,4,5,5'-hexachlorobiphenyl |
| 14) 2,2',3,4,4',5'-hexachlorobiphenyl |
| 15) 2,2',3,4',5,5',6-heptachlorobiphenyl |
| 16) 2,2',3,4,4',5',6-heptachlorobiphenyl |
| 17) 2,2',3,4,4',5,5'-heptachlorobiphenyl |
| 18) 2,2',3,3',4,4',5-heptachlorobiphenyl |
| 19) 2,2',3,3',4,4',5,5',6-nonachlorobiphenyl |
| 20) Decachlorobiphenyl (I.S.) |

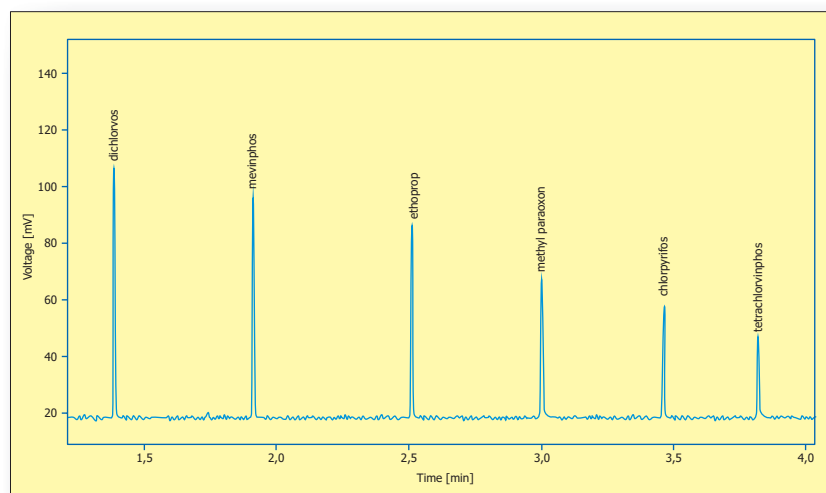
Conventional vs. Fast GC: traditional run time for typical PCBs analysis of 20 min is reduced to 5 min utilizing a fast ramp rate (35 °C/min) and a short 100 mm I.D. column.

NPD - Nitrogen-Phosphorus Detector

Due to its selective and sensitive response to nitrogen and/or phosphorus containing compounds, the system is commonly used to detect pesticides, herbicides, and drugs of abuse.

FPD - Flame Photometric Detector

Selectively detects compounds containing sulfur or phosphorus. Outstanding performances can be observed in the analysis of sulfur compounds in natural gas and organophosphorous pesticides in agriculture, food, flavor and fragrance applications.



Determination of organophosphorous pesticides in tangerine essential oil by means of Fast GC-FPD: increased laboratory throughput without losing sensitivity; MDLs of 0.05 ppb are achieved.

MASTERTOF-MS Detector

Performs fast acquisition rates (1,000 spectra/s) and wide linear dynamic range (10^5). In combination with the MASTER GC, the system is the ideal solution for Fast GC and GCxGC analyses. In addition, the proprietary MASTER LAB software solution is based on an innovative platform for acquiring and processing mass spectral data. Original deconvolution algorithms capable to handle the large amount of information in a smart and effective way permit reliable identification of trace compounds even in complex matrices.

User Friendly Interface

The MASTER GC incorporates an intuitive and easy to use touchscreen interface that provides quick and easy set up and control. The system can also be software-controlled by the functional and user friendly CLARITY™ Chromatography Station.



Unlike other commercially available fast gas chromatographs, the MASTER GC offers guided diagnostics and maintenance procedures supporting the user in the preservation of the systems precision. The outcomes can be monitored and controlled through the touchscreen display.

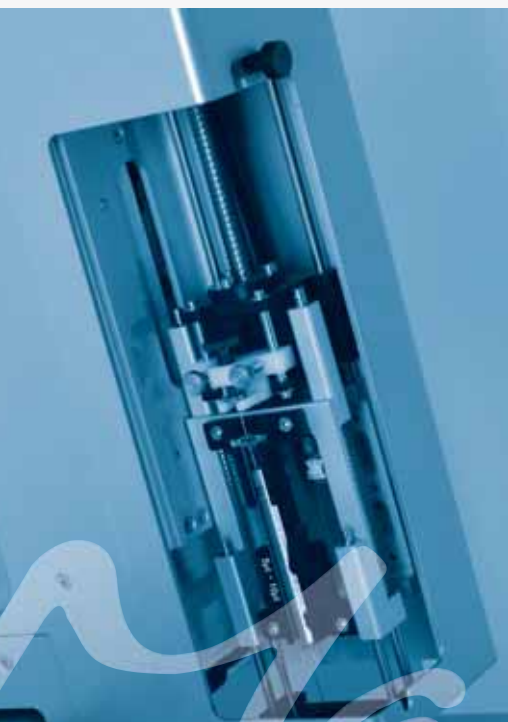
For extra convenience, the MASTER GC is equipped with a lamp which can be used to illuminate the oven, aiding in the installation of the column, especially when multiple column configurations are to be used.



MASTER AS

Autosamplers are responsible for the first steps of an analysis and can significantly increase result repeatability and extend analytical capabilities. The MASTER AS Liquid Autosampler, a robotic X-Y-Z coordinate sampling system, delivers superior flexibility, repeatability, and performance to increase sample throughput and meet each laboratory's changing workload.

The easy to use liquid autosampler is totally controlled through the MASTER GC touchscreen. Analysis can be performed unattended by using the straightforward interface to set all parameters and the AS Sequences.



Unlike built-in autosamplers, the extremely flexible MASTER AS features three separate and removable 2-mL vial racks for a total capacity of 160 samples. Furthermore, 10-mL and 20-mL vial racks are also available for a capacity of 65 samples. Screw, crimp, and snap top vials can be used according to the users' needs and convenience. The autosampler has a capacity for up to five 10-mL solvent vials and up to five 10-mL waste vials, presenting numerous solvent possibilities to eliminate carry-over. Additionally, the sample trays are far from the GC oven, preventing possible sample degradation and solvent evaporation caused by heat exposure.

All injection parameters can be optimized according to the laboratory's needs, the sample type, and the application. The MASTER AS allows the utilization of up to seven different syringe capacity types ranging from 5 μL to 500 μL , offering a great choice of injection volumes from 0.1 μL to 500 μL . The syringe can be easily exchanged by using the Syringe Replacement function, which brings the Y axis of the MASTERAS to a handy position.

The MASTER AS presents unmatched injection capabilities. The same vial can be sampled up to 100 times and the sample can be introduced into three different injectors without requiring autosampler re-alignment or any calibration procedure.

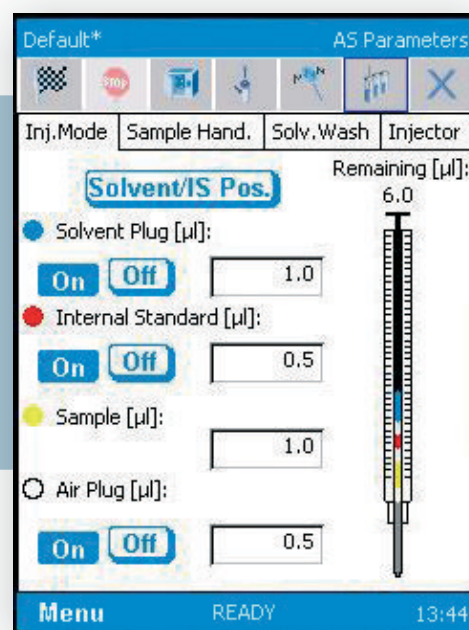
Flexibility can be enhanced by the Internal Standard (I.S.) addition procedure. To increase precision the MASTER AS performs I.S. addition by withdrawing a preset volume of the standard solution and separating it from the sample by a small volume of air.

In addition, sample handling, solvent washing, and injection parameters can be set to ensure maximum precision and accuracy. Among these parameters are: solvent and sample rinse volumes and number of rinses, number of plunger strokes, sample taking height, sampling and plunger injection speed, viscosity delay, pre and post injection delay time, and injector needle depth.

The solvent rinses eliminate carry-over, the plunger strokes guarantee precise injection volumes, the set up of variable needle depths allows small volumens and multi-phase samplings.



Four different injection modes are displayed: Sample (standard injection mode), Air Plug, Solvent Plug, and Internal Standard. The system enables the combination of these modes to meet all sampling requirements, while enhancing precision and performance. The scheme of a syringe is shown on the touchscreen display to better visualize the selected mode; each mode is represented by a color.



Compound	Conventional GC	Fast GC
	Area RSD %	Area RSD %
C10	0.04	0.23
C20	0.03	0.16
C22	0.03	0.14
C24	0.05	0.18
C26	0.05	0.17
C28	0.06	0.21
C30	0.03	0.22
C32	0.03	0.23
C34	0.11	0.23
C36	0.06	0.27
C38	0.13	0.28
C40	0.09	0.21

The excellent area repeatability is shown by the extremely low RSD % values from ten injections in conventional and Fast GC.

Optionals and Accessories

DANI's extensive line of instruments, chromatography supplies, accessories, and columns are designed, manufactured, and tested to help the most demanding analytical problems.

The MASTER GC can be equipped not only with up to three injectors and three detectors simultaneously, but it also features the possibility to set up two auxiliary temperatures and three auxiliary pressures (one out of these is settable as auxiliary flow), allowing the use of an extended number of external devices.

For extended application capabilities the MASTER GC can be also coupled with the automated sampling systems MASTER DHS Dynamic Head Space Sampler, MASTER TD Thermal Desorber, and HSS 86.50 Headspace Sampler.

Auxiliary ovens, gas sampling and switching valves, methanizer, GC oven cryogenic cooling device, and other optional devices make the MASTER GC the most suitable gas chromatograph for the development of complex analytical systems.

Two auxiliary ovens with different capacities are available to house valves and columns for specific multidimensional applications.

For low level carbon monoxide and carbon dioxide detections the MASTER GC can be equipped with the methanizer to reach the sensitivity level of the FID. The catalytic reduction of carbon monoxide and carbon dioxide to methane through a Nickel catalyzer permits their detection at levels below 1 ppm.

DANI offers an extended variety of columns for almost any chromatographic application, ranging from packed to conventional and Fast GC capillary columns. A wide selection of non-polar, intermediate polarity, polar and chiral high-quality stationary phases are available. Moreover, stationary phases dedicated to specific applications such as biodiesel, polycyclic aromatic hydrocarbons, solvents, phosphorous pesticides, alkaline compounds, and saturated and unsaturated triglycerides are also provided.

All the columns are engineered and tested to meet performance and robustness, featuring low bleed levels and outstanding inertness.



Turn-key Analyzers and Total Solutions

DANI offers complete solutions, including instrumentation, applications, supplies, and services, providing specialized Turn-key Analyzers and Total Solutions to meet the most challenging analytical demands.

The flexibility and upgradeability featured by the MASTER GC easily support an array of custom configurations for special applications. From the retrofit of a single gas sampling valve and a packed column to four-valve three-channel systems with multiple columns. The Total Solutions include instrumentation, analytical method development, data processing, training, supplies and services, aligning technology to the customers' needs.

Complete Software Control

The CLARITY™ Chromatography Station provides full control of the MASTER GC and the MASTER AS and offers data acquisition and processing. Drivers are also provided for a broad series of commercially available systems. The advanced chromatography station is designed to control up to four instruments and to acquire and evaluate up to four signals from each instrument simultaneously.



The CLARITY™ user interface combines functionality with simplicity of use, offering instrument control and the intuitive generation of data handling methods. The graphical interface includes self-explanatory icons and windows for quick operation.

Data Acquisition and Processing

After the fast and easy method set up, data acquisition can be started. The acquisition method and the chromatogram are displayed in real time. The software also enables the set up of sequences, batch processing, and automated actions directly from the events table.

CLARITY™ algorithms enable to detect an unlimited number of peaks in each chromatogram and analysts can finely tune their integration. Extensive integration parameters are available, such as peak width, threshold, tangent slope ratio etc.

A variety of quantification and calibration methods are also incorporated in the data module. External and internal standard methods and six types of calibration curves are supported.

The graphical tools of CLARITY™ permit to display and overlay an unlimited number of chromatograms and to perform operations like zooming, shifting, scaling etc.

Customized Reports

Analysis reports can be customized and stored as report files. Reports can be saved as templates and automatically generated to improve the output of routine laboratories. Obtained data can be exported to various data formats.

Data and system validation

In addition, CLARITY™ offers the System Suitability Test (SST), a module designed to validate the chromatography system based on the evaluation of acquired chromatograms that controls if certain components comply with selected parameters (calibrated quantity, retention time, asymmetry etc.).

The flexible and robust CLARITY™ software addresses the requirements of the FDA's directive 21 CFR Part 11 by delivering a series of validation tools such as user access control, validation records, and audit trails.

The security and control of chromatographic data according to Good Laboratory Practice (GLP) and FDA Directive 21 CFR Part 11 are guaranteed through the following dedicated tools:

- **Protection of chromatographic data:** to prevent unauthorized interventions the user accounts can be limited through access rights and passwords.
- **Electronic signature:** to assure traceability, data are stored with user name, date, time, and purpose of signature.
- **Audit Trail:** to log all individual operations; operations may also be logged with chromatograms, calibrations, sequences, and methods. The backward control is also allowed to easily analyze the conditions that may lead to errors or instabilities. The records can also be exported to .txt and .csv formats.



A SCENT OF FUTURE

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