Get a

second dimension

of information on complex mixtures

Capillary Flow Technology

GCxGC Flow Modulator

Our measure is your success.

products | applications | software | services

Agilent Technologies

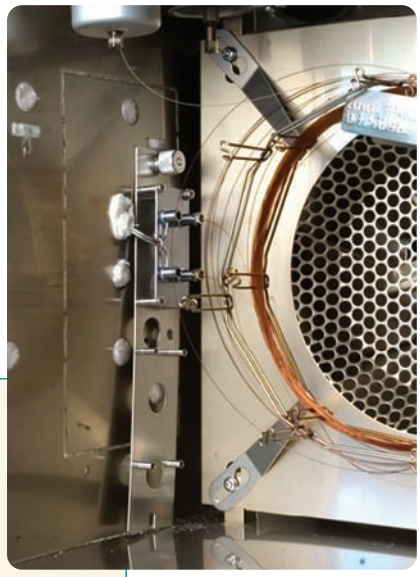
Maximize information
while collecting and analyzing GC data

Comprehensive two-dimensional GC, or GCxGC, is a powerful technique that can be used to separate very complex mixtures – such as those found in the hydrocarbon processing, environmental, and food/fragrance industries.

Agilent's GCxGC method uses two columns, typically of very different polarities, installed in series with a modulator in between. The second column is much shorter than the first column to effect a fast separation. The entire assembly is located inside the GC oven. The modulator performs three functions (Figure 1):

1. It collects effluent from the first column for a fraction of the time equal to peak width. For example, if a peak from column one is six seconds wide, the modulator will accumulate material every two to three seconds, thereby dividing the peak from the first column into two or three "cuts."
2. It focuses the material collected from each cut into a very narrow band.
3. It introduces the bands sequentially onto the second column, resulting in additional separation for each band injected onto the second column.

This technique provides a second dimension of information that can increase the peak resolution and capacity. In effect, its peak-generating ability is much greater than that of a single-column separation.



GCxGC Flow Modulator attachment

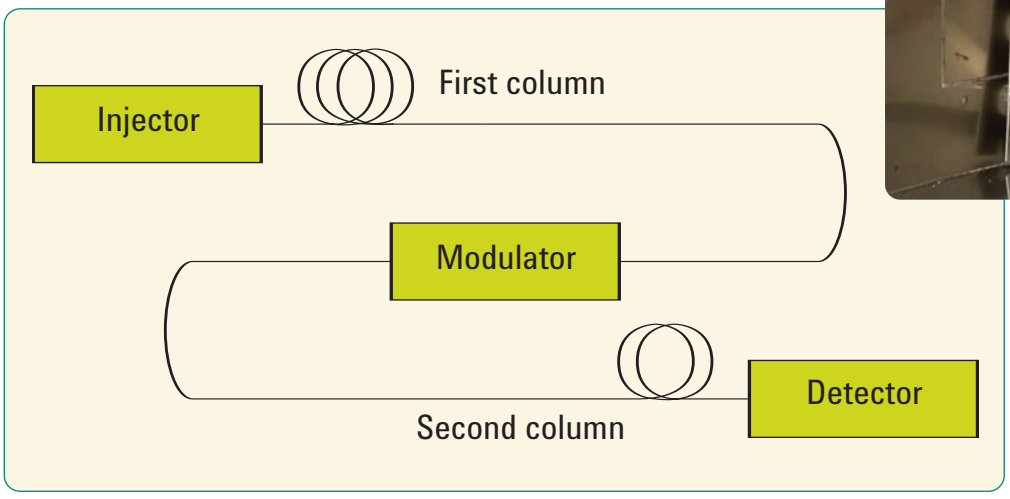
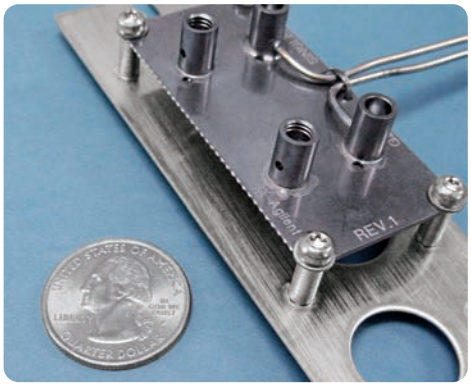


Figure 1. *GCxGC uses a primary column (conventional separation), a flow modulator, a second column (very fast separation), and a fast detector.*

Separate complex mixtures **without complex hardware**

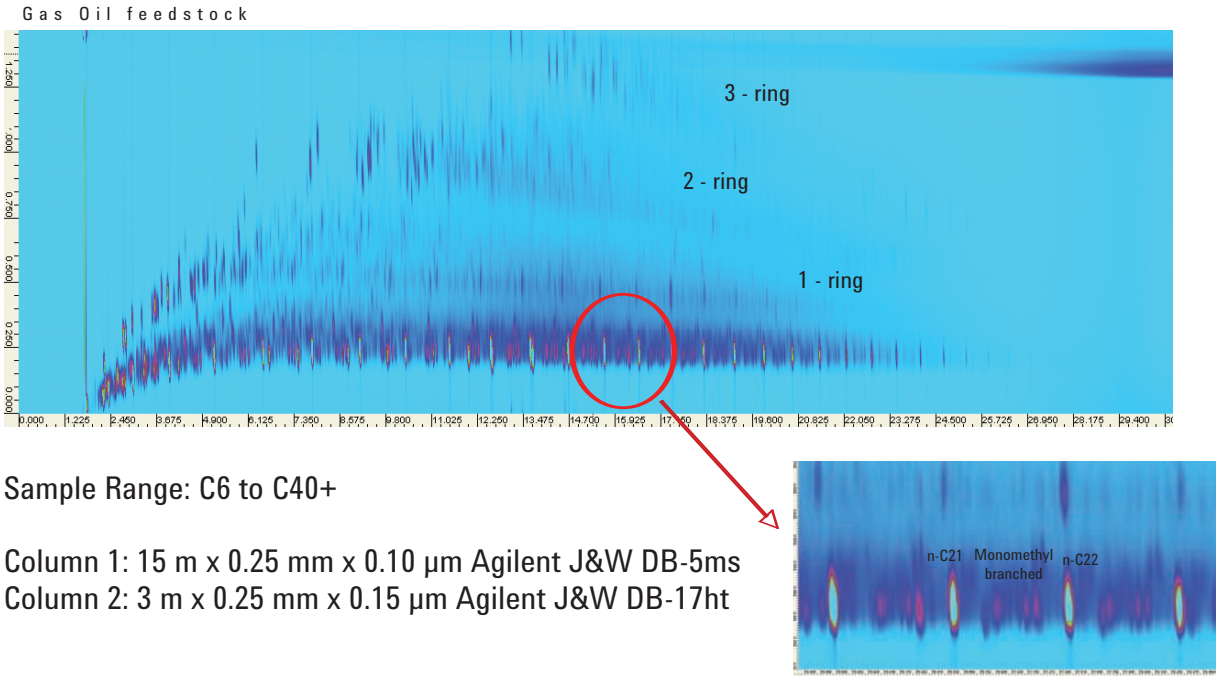


Compact design simplifies GCxGC without the need for expensive cryo gases by using flow modulation.

A number of different modulator designs exist, most relying on thermal cycling to focus the bands from the first column and release them into the second column. There are some disadvantages to this approach:

- Large usage of expensive cryogenic gases leading to a high cost of analysis
- Complexity of the hardware
- Longer analysis times

Agilent's proprietary Capillary Flow Technology and fourth-generation Electronic Pneumatics Control (EPC) enable the use of a differential flow modulator to conduct comprehensive GCxGC without the use of cryogenic gases or complex hardware.



Sample Range: C6 to C40+

Column 1: 15 m x 0.25 mm x 0.10 µm Agilent J&W DB-5ms
Column 2: 3 m x 0.25 mm x 0.15 µm Agilent J&W DB-17ht

Flow Modulation Applied to a Gas Oil Feedstock

How it works: **the modulator is key**

The Capillary Flow Technology modulator uses a deactivated, stainless steel structure with all flow splitters and the collector channel incorporated internally in the device. With its low thermal mass, it can track the oven temperature very closely, while its GC oven location allows precise temperature control without lag during programmed runs. All external connections are made using Agilent's Ultimate Union technology for leak-free operation and extremely small, well-swept volumes. A micro three-way solenoid valve, installed on the side of the gas chromatograph, connects to a pneumatics control module (PCM) to accurately and precisely control flow through the modulator.

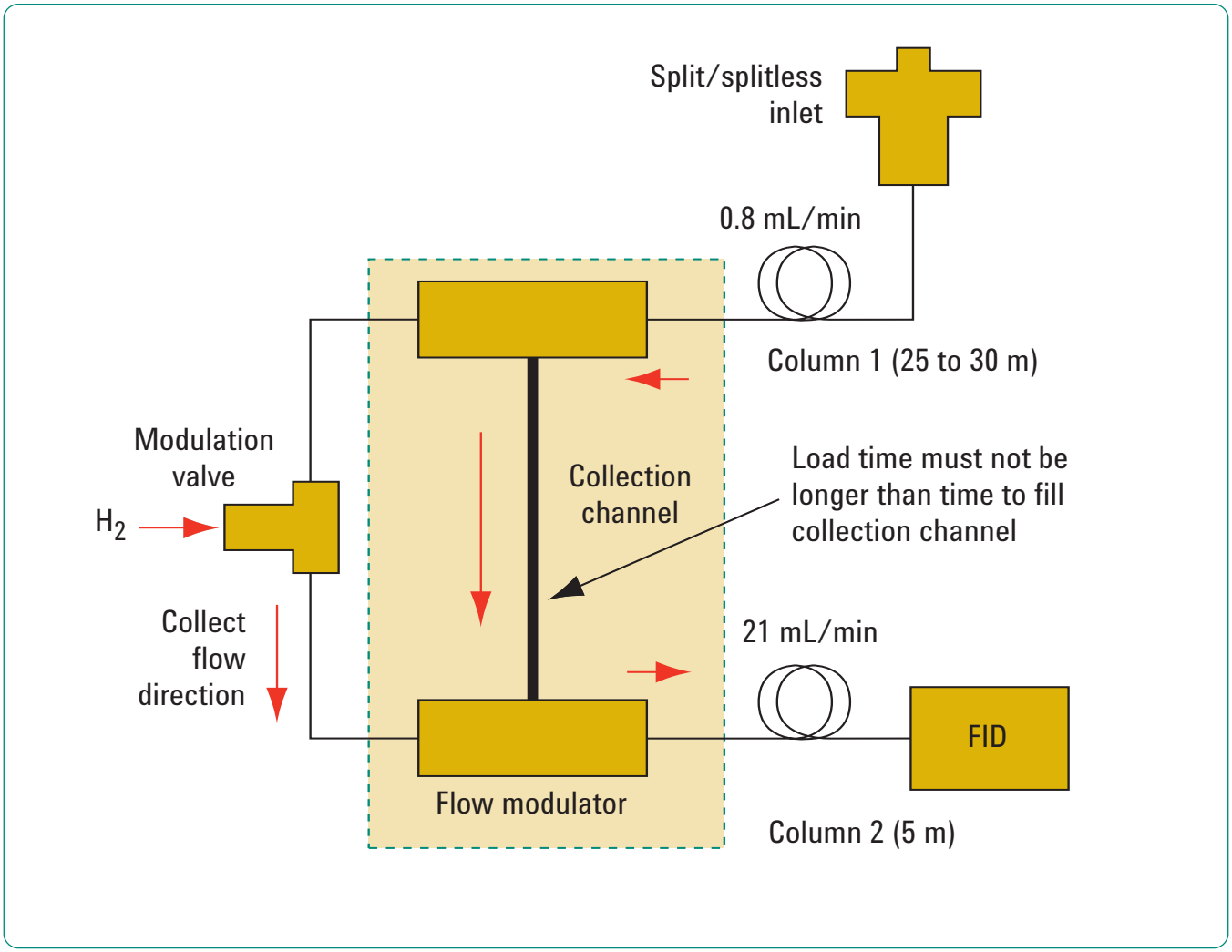


Figure 2. ***Load or collect state*** *(above): At the beginning of this state, the collection channel is filled with hydrogen gas from a previous injection cycle flush. The primary column effluent enters the modulator's top tee connection and flows into the collection channel. The analytes from this column enter one end of the collection channel. Hydrogen flow from the PCM/three-way micro valve exits the modulator at the bottom tee and is sent to the second column.*

Figures 2 and 3 illustrate the modulator. A three-way solenoid valve receives a controlled supply of hydrogen gas from a PCM. The periodic switching of this three-way valve drives the modulator. The precisely timed and synchronized switching between the *collect* and *inject* states directs discrete sample pulses continuously to the second column for additional fast separation throughout the chromatographic run.

Inject or *flush state* (below): Hydrogen gas flow from the three-way solenoid valve is directed to the top tee. A high flow of typically 20 mL/min for about 0.1 second rapidly flushes the collection channel, transferring material in a very narrow band onto the second column where any analytes collected in the channel undergo rapid separation.

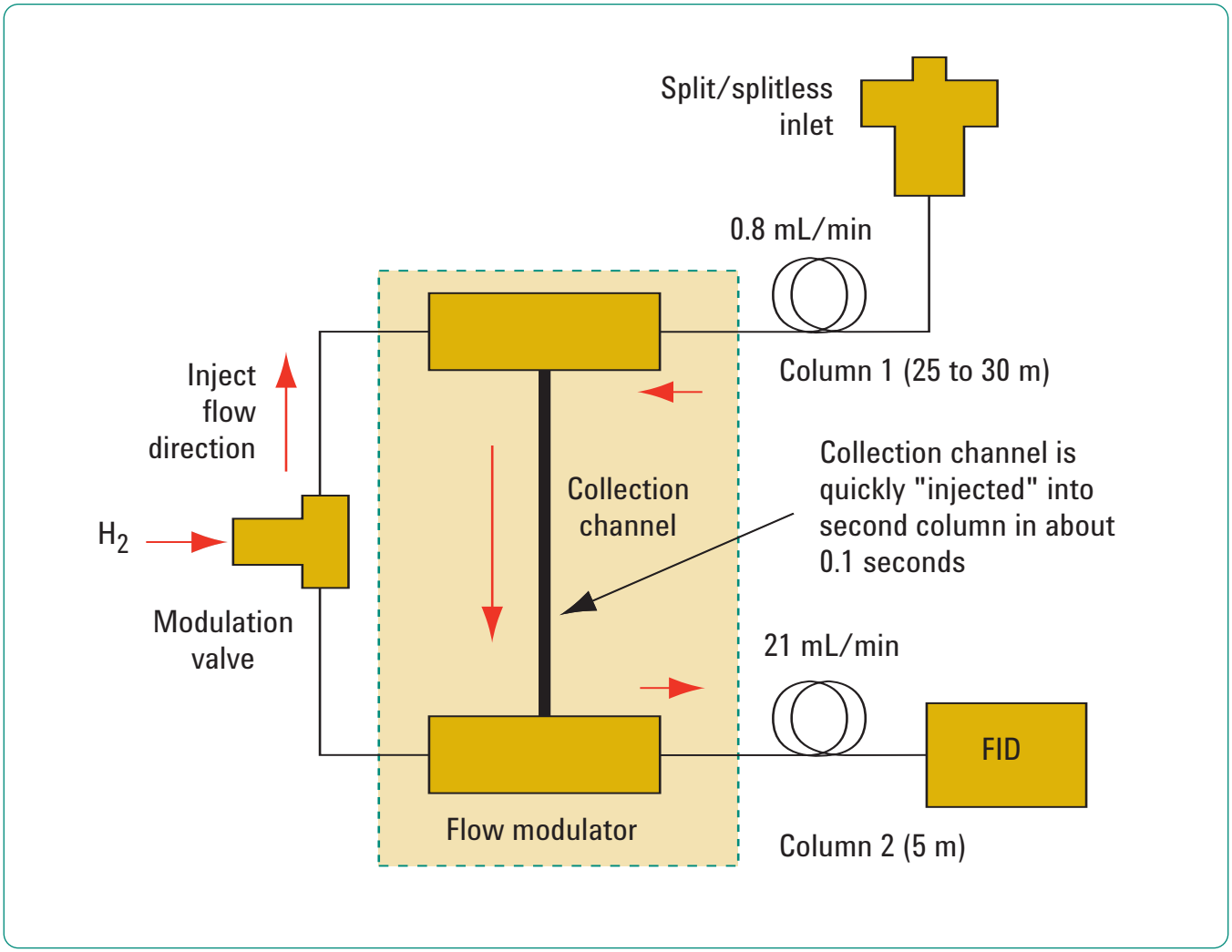


Figure 3. *Flow rates and flow directions during the transfer or inject portion of the modulation cycle.*

Two Ways to Benefit
from Agilent's Capillary Flow Technology

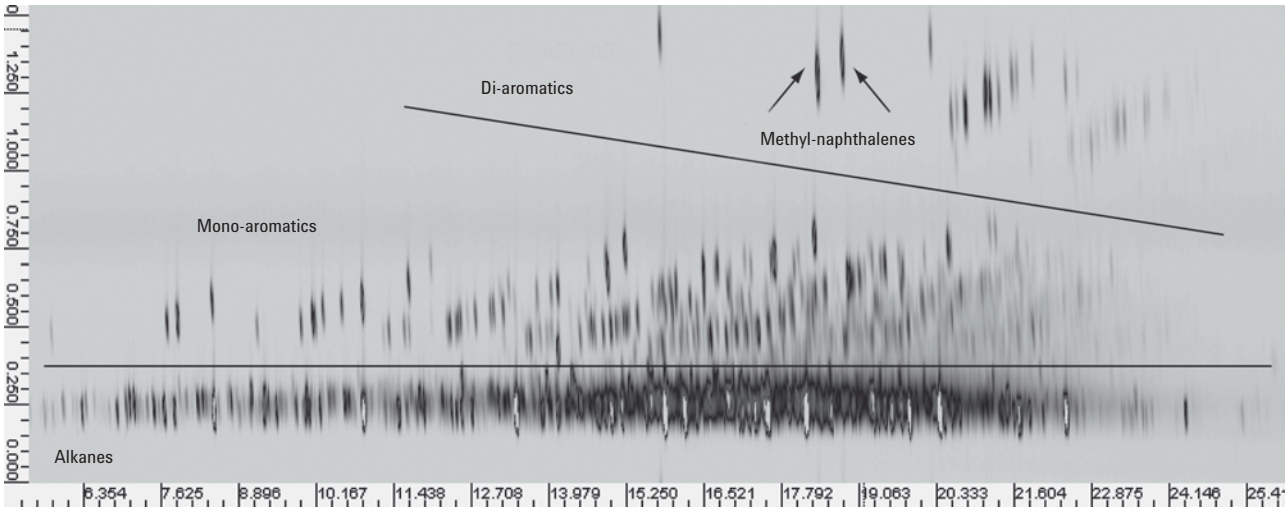


Figure 4. *GCxGC image of No. 2 Kerosene*

Comprehensive Flow Modulated Two-Dimensional Gas Chromatography System

Agilent Application Brief 5989-6078EN
Industries: Hydrocarbon Processing

GCxGC using a flow modulator based on Agilent's Capillary Flow Technology is used to show different classes of hydrocarbons in a kerosene sample and separation of C16 and C18 FAMEs in a biodiesel sample.

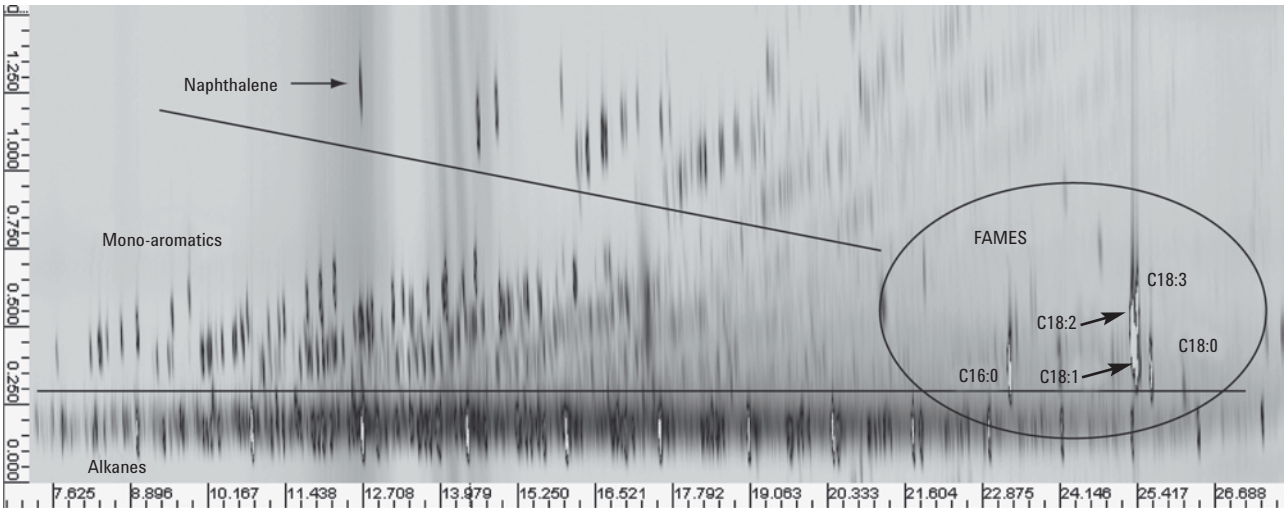


Figure 5. *GCxGC image of a B20 soy-based biodiesel (20% methyl ester, 80% diesel)*

What you need
to get started with GCxGC

- Agilent 7890A GC with firmware version A.04.06 or higher
- FID with 200 Hz data collection rate
- Split/splitless inlet
- Capillary Flow Technology modulator option or accessory
- Capillary Flow Technology modulator checkout kit
- Pneumatics control module (PCM)
- Agilent GC ChemStation B.03.02 or other data collection and analysis system that can control the flow modulator cycle
- 30 m x 0.25 mm x 0.25 µm DB-5ms column (included with option or accessory)
- 5 m x 0.25 mm x 0.15 µm INNOWax column (included with option or accessory)
- GCxGC data analysis software (not provided by Agilent)
- Internal column nuts and SilTite ferrules

Use these part numbers for easy ordering

Description	Part Number
7890A GC with Capillary Flow Technology Modulator (requires checkout kit)	G3440A Option 887 or accessory G3486A
7890A GC with 200 Hz FID	G3440A Option 221 or accessory G3462A
7890A GC with split/splitless inlet	G3440A Option 112 or accessory G3452A
Capillary Flow Technology modulator checkout kit	G3487A
PCM for 7890A GC	G3440A Option 309 or accessory G3471A
SilTite Metal ferrules, 1/16 in x 0.4 mm ID, 10/pk, includes 2 column nuts	5184-3569
Agilent 32 bit ChemStation for 1 GC	G2070BA
Agilent 32 bit ChemStation Bundle for 1 GC includes: • G2070BA 32 bit ChemStation software • Computer with monitor and Windows operating system • Printer	G1875BA
GCxGC data analysis software Recommend GC Image software, which can be purchased from Zoex Corporation	www.zoex.com

A total portfolio of solutions from the leader in GC and GC/MS technology

When you buy instruments and systems from Agilent, you get more than just reliability.

You also get:

- **Over 40 years** of chromatography expertise and industry leadership.
- **Agilent J&W GC columns, calibration kits, mix cylinders, and filters** that conform to the industry's most stringent specifications, so you know they will deliver unbeatable precision, performance, and sensitivity.
- **Application solutions** that let you maintain stringent practices from sample preparation to analysis. So you can achieve rapid, reliable results that stand up to scrutiny.
- **Informatics software** for managing large quantities of data and preserving the integrity and security of your results.
- **World-class, global service and support** – on the Web, by phone or in person – that can save your lab time, optimize instrument use, and increase productivity.

For more information

Read: **Agilent G3486A Capillary Flow Technology Modulator User Guide Agilent Manual, Publication Number G3486-90010**

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U.S. and Canada **1-800-227-9770, agilent_inquiries@agilent.com**

Europe **info_agilent@agilent.com**

Asia Pacific **adinquiry_aplsca@agilent.com**

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