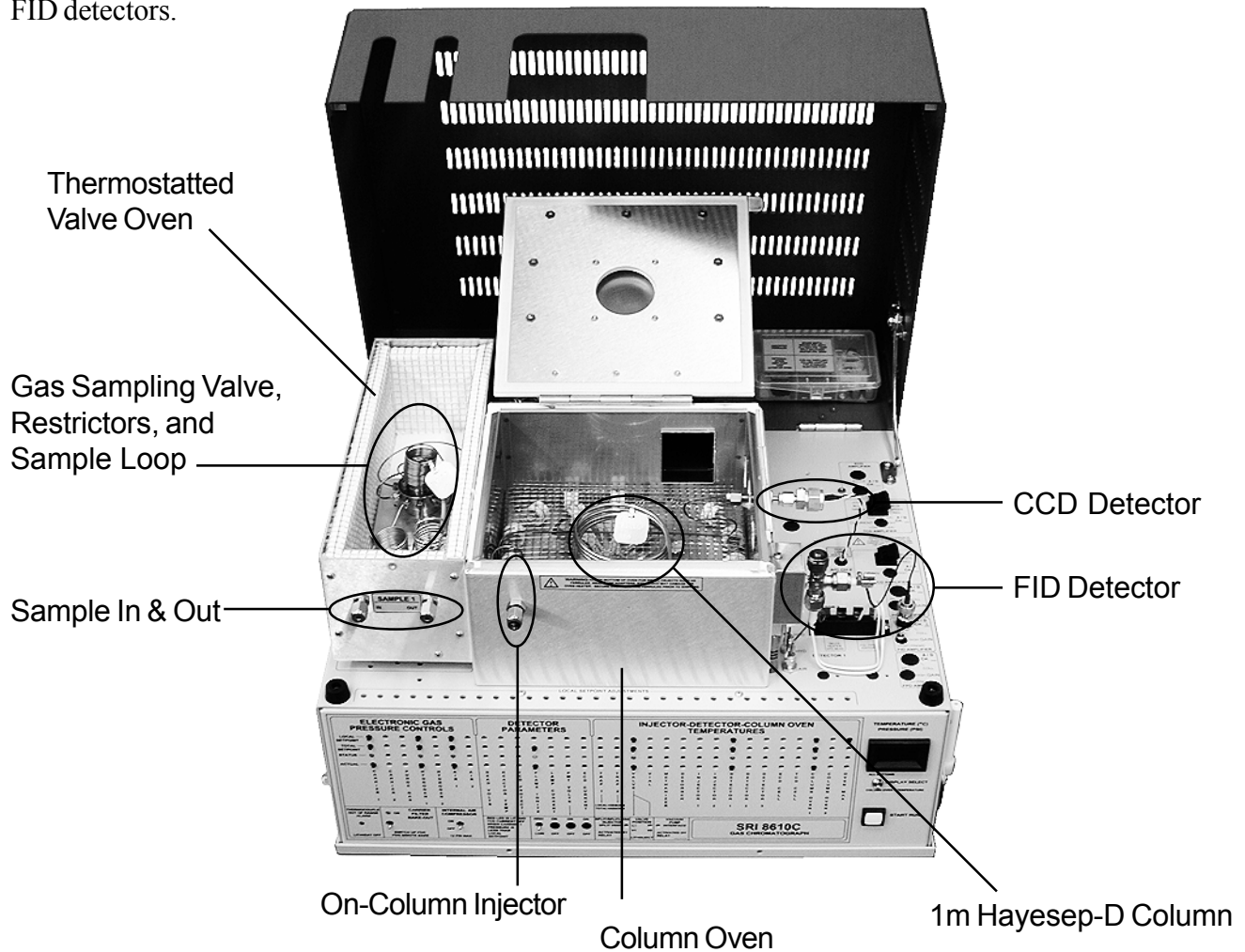


## System Overview

The Mud-Logging GC system is designed to provide a continuous reading of total hydrocarbons in a gas stream, while periodically performing a chromatographic separation of the sample to determine the composition of the sample gas stream. This is accomplished using a 10 port Gas Sampling Valve with a 25 $\mu$ L Sample Loop in a thermostatted Valve Oven, a 1m (3') Hayesep D packed column in a temperature programmable Column Oven, a CCD detector, an FID detector and a built-in Air Compressor. This GC can be modified to incorporate a second FID instead of the CCD for total hydrocarbon monitoring. The model shown below has CCD and FID detectors.



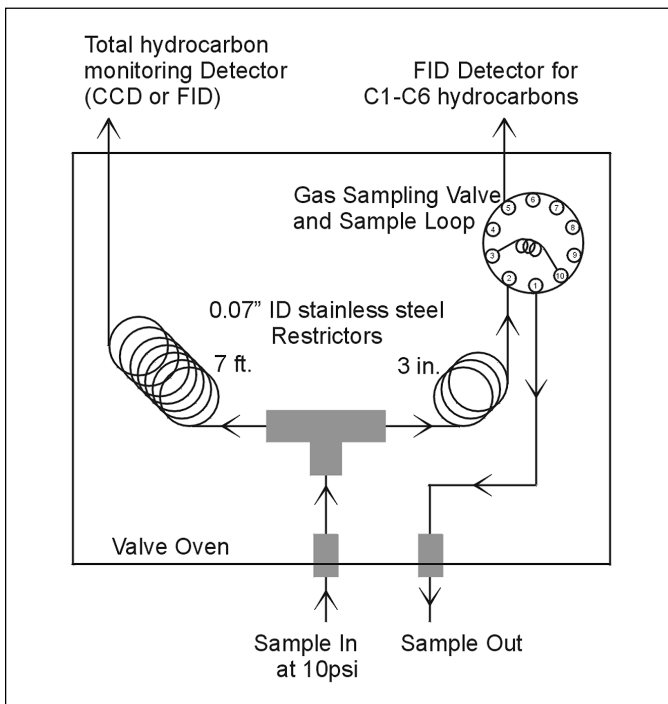
Speciation of C<sub>1</sub>-C<sub>6</sub> hydrocarbons is handled by the Gas Sampling Valve, Hayesep-D column, and FID while the CCD provides continuous, total hydrocarbon monitoring. Detection limits for this system are 0.1% to 100% for the continuous total hydrocarbon monitor, and 0.005% to 100% for speciated hydrocarbons using the FID. The Air Compressor supplies combustion air for the FID, and the air make-up for the CCD. The built-in PeakSimple data system displays both the continuous total hydrocarbon reading, using the Data Logger mode, and the separated peaks. When the system receives out-of-range readings, an alarm function may alert the user.

# POPULAR CONFIGURATION GCs

## Mud-Logger

### Theory of Operation

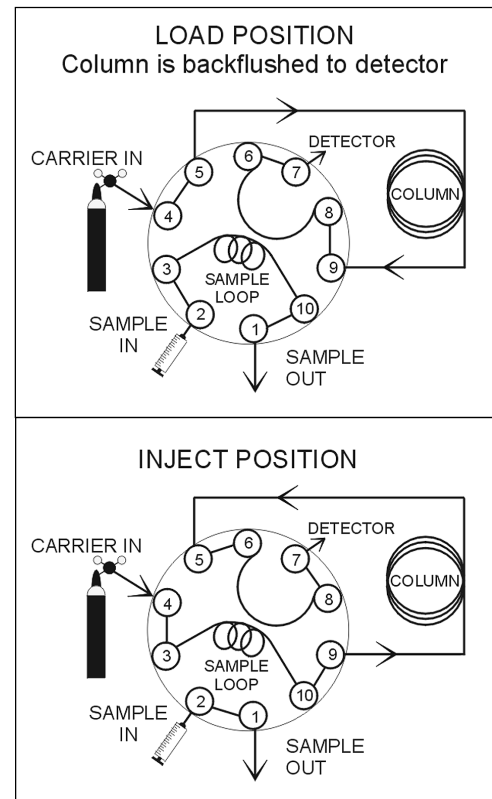
The sample gas stream is connected to a bulkhead fitting on the system's thermostatted Valve Oven where it flows through the sampling loop of the 10 port Gas Sampling Valve, and also to the CCD detector. The fitting labelled "Sample In" (pictured at right) on the front of the Valve Oven is the sample gas stream inlet. The user must regulate the pressure of the sample stream so that it enters this inlet at 10psi. The instrument is factory preset to deliver 5mL/min to the CCD at 10psi. The remainder of the flow, approximately 100mL/min, passes through the Sample Loop. This relatively high flow rate gets the sample from the sampling point into the GC with minimal delay.



Once the sample enters the inlet, its path is T'd through two restrictors and on to the detectors. To avoid damaging the CCD, the maximum pure hydrocarbon flow to reach this detector is 5mL/min. The restrictors regulate the flow to the CCD to 5mL/min when the sample inlet pressure is 10psi. The remainder of the sample stream (approximately 100mL/min) flows through the Gas Sampling Valve's loop and is periodically injected into the Hayesep-D column, then detected by the FID.

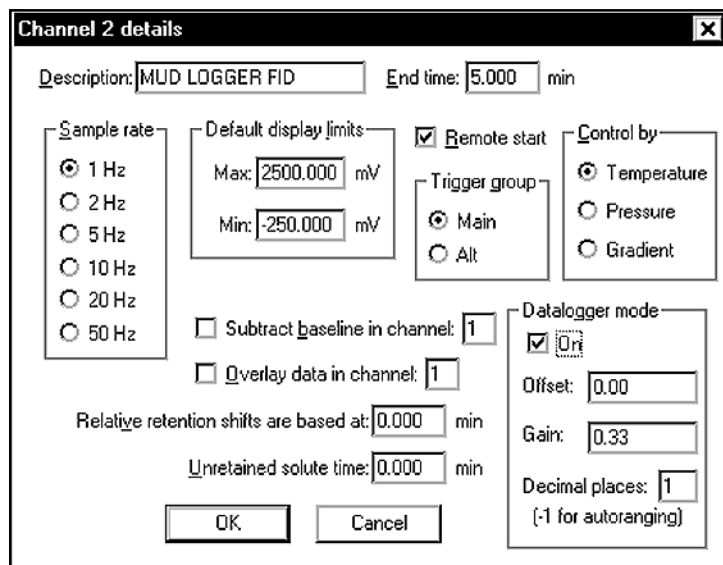
### 10 Port Gas Sampling Valve

At an automatically repeating time interval controlled by the user with the built-in PeakSimple data system, the Gas Sampling Valve injects the contents of its sample loop into the Hayesep D packed column where it is separated into the constituent hydrocarbon (C<sub>1</sub>-C<sub>6</sub>) peaks and detected by the FID detector. Between automatic sample injections into the column, the 10 port Gas Sampling Valve is in LOAD position (top right schematic). In this position, the carrier gas flows into the column while sample gas flows through the 25µL Sample Loop and to vent. When PeakSimple automatically moves the valve to the INJECT position (bottom right schematic), the carrier gas flows through the Sample Loop first, then sweeps the sample into the Hayesep-D column.



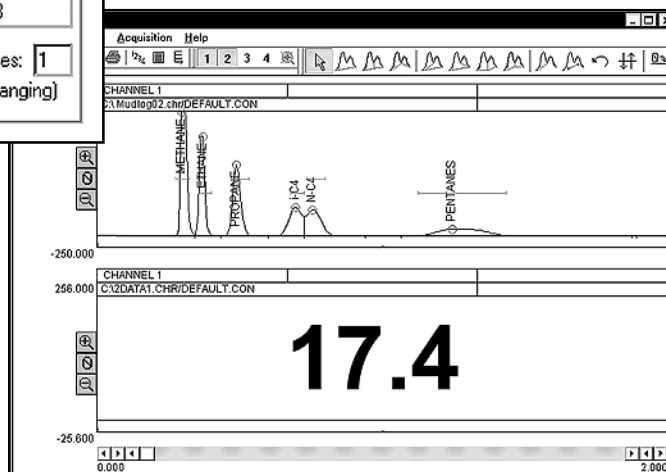
**General Operating Procedure Part 1:  
Total Hydrocarbons Using the CCD Detector**

1. Connect zero gas to sample inlet at 10psi. Zero gas has no hydrocarbons.
2. Zero the CCD detector signal using the Auto Zero button for its channel (typically channel 2).
3. Connect calibration gas standard to the sample inlet at 10psi. Calibration gas is typically 100% methane.
4. The CCD signal will increase approximately 300 millivolts while running 100% methane.
5. In PeakSimple, open the CCD Channel Details dialog box by right-clicking in that channel's chromatogram window. Enter the gain factor which will multiply the 300 millivolt signal to produce the desired concentration unit. For example:  $300 \times .33 = 100$  if the desired unit is percent.  
 $300 \times 3333 = 1,000,000$  if the desired unit is parts per million
6. Also in the Channel Details dialog box, select Data Logger mode by clicking in the appropriate checkbox. The CCD signal times the gain factor will be displayed on the screen in large numbers.



PeakSimple  
Channel Details dialog box

Chromatogram with  
channel 2 in Data Logger mode



## POPULAR CONFIGURATION GCs Mud-Logger

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### ***General Operating Procedure Part 2: Speciated Hydrocarbons Using the FID Detector***

1. Connect the calibration gas standard to the sample inlet at 10psi.
2. Set the Valve Oven temperature to 90°C.
3. Ignite the FID.
4. Set an isothermal Column Oven temperature program as follows:

Initial Temp	Hold	Ramp	Final Temp
200°C	5.00	0.00	200°C

5. Type in an even table as follows:

Time	Event
0.00	Zero
0.050	G ON
1.5	G OFF

6. Set the FID gain to MEDIUM.
7. Start the analysis by hitting the spacebar on the computer keyboard.
8. In PeakSimple, input the retention windows to identify the individual hydrocarbon components (methane, ethane, propane, butane, etc).
9. Calibrate the individual hydrocarbon peaks.
10. This instrument is plumbed for backflush. This gives the user the option to set the valve program to backflush the heavier hydrocarbons after the desired peaks have been separated. For instance, if your application required separation of hydrocabons up to C<sub>5</sub>, you could set the valve to backflush after the elution of the C<sub>5</sub> component(s), and all the heavier hydrocarbons would together produce one large peak.

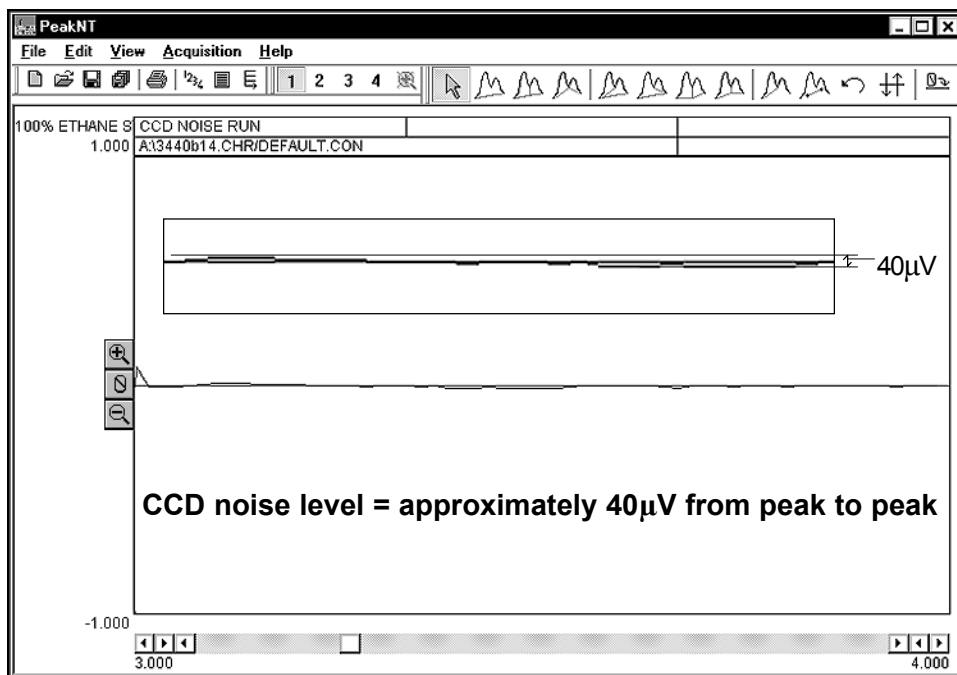


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**Expected Performance**



**CCD Noise**

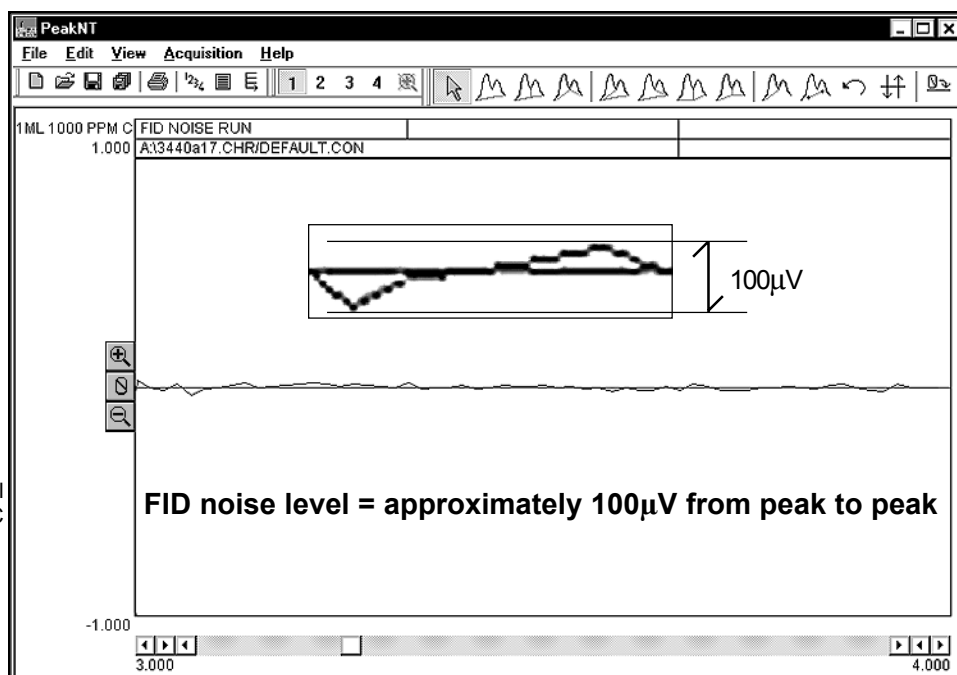
Column: 1m Hayesep-D  
Carrier: Air @ 10mL/min  
Air make-up = 100mL/min

Temperature program:  
Initial Hold Ramp Final  
80°C 5.00 0.00 80°C

**FID Noise**

Column: 1m Hayesep-D  
Carrier: Helium @ 10mL/min  
FID gain = High  
FID temp = 150°C  
FID ignitor = -400  
Valve temp = 90°C

Temperature program:  
Initial Hold Ramp Final  
80°C 5.00 0.00 80°C

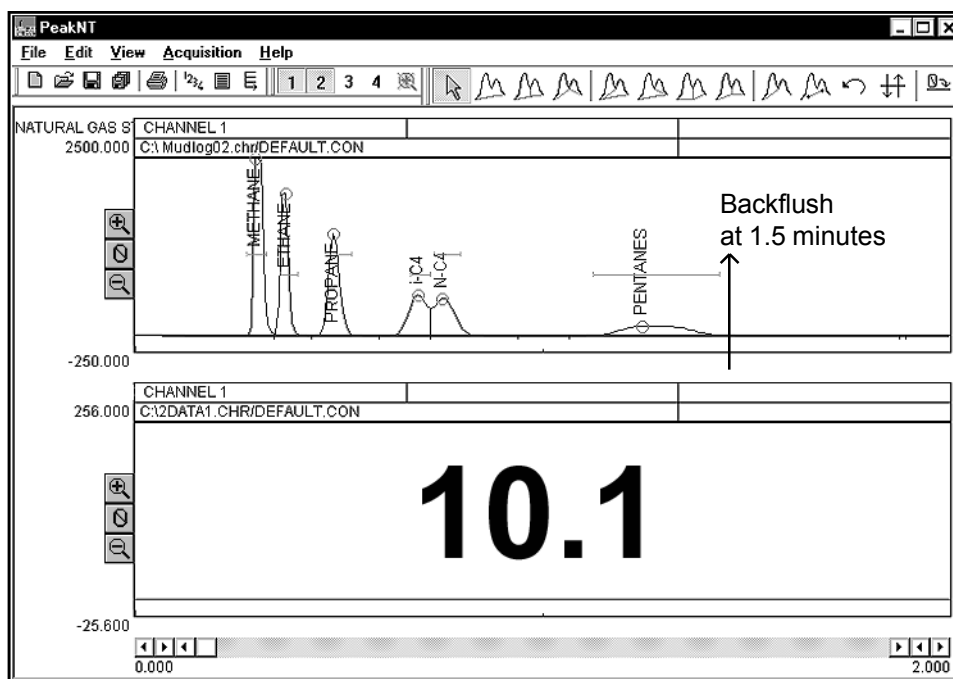


# POPULAR CONFIGURATION GCs

## Mud-Logger

### Expected Performance

#### Factory Test Run of a Standard Mud-Logging System (FID and CCD)



Column: 1m Hayesep-D  
 Carrier: Helium @10psi  
 Sample: Natural Gas standard  
 Method: Valve injection  
 FID H2 = 30, FID air = 6  
 FID temp = 150°C  
 FID ignitor = -750  
 FID gain = MEDIUM  
 Valve temp = 90°C

Temperature program:  
 Initial Hold Ramp Final  
 200°C 5.00 0.00 200°C

Events:  
 Time Event  
 0.000 Zero  
 0.050 G ON  
 1.500 G OFF

#### Results:

Component	Retention	Area
Methane	0.291	6664.1410
Ethane	0.366	2770.3785
Propane	0.483	2762.6450
i-C4	0.691	1754.0118
n-C4	0.750	1913.8415
Pentanes	1.241	1580.4310
<b>Total</b>		<b>17445.4488</b>