CHASSIS DYNAMOMETER TEST CELLS

ENGINE DYNAMOMETER TEST CELLS

Fuel Economy Meter

A SEMTECH ECOSTAR Product

TEST CELL EMISSIONS MEASUREMENT SOLUTIONS

Mustang Advanced Engineering offers a complete lineup of SEMTECH ECOSTAR products for engine and chassis dynamometer test cell emissions measurement.

The SEMTECH-FEM is an all-new fuel economy meter with unsurpassed accuracy and ease of use. This patent pending design combines our high speed, high performance exhaust flow meter with a re-designed CO/CO_2 gas analyzer and packages them into an integrated system, providing accurate, real-time fuel economy measurements using the carbon balance method.

Sample handling is integrated into the system, with an internal sample probe, heated filter, Nafion dryer, and coalescing filter. The dried and filtered sample then passes through a non-dispersive infrared analyzer for measurement of CO, CO_2 and HC as hexane. An optional paramagnetic oxygen sensor completes the gas analysis. The system is easily controlled through an intuitive graphical touch screen on the electronics module, or through the host software. Mass flow, mass emissions and fuel economy values can be monitored live, along with exhaust pressure and temperature. The system accommodates standard flow tube sizes from 1" through 6" diameters, and is also scalable, enabling custom sizes upon request. The module can operate as a stand-alone analyzer or as part of the SEMTECH ECOSTAR mobile test bench.

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The MAE-FEM was designed to measure exhaust flow, CO and CO^2, both on-board and in the test cell. The system is comprised of a high performance flow meter, and a Non-Dispersive Infra-Red (NDIR) gas analyzer, with the following features and benefits:

High Speed Sampling: The SEMTECH-FEM internally samples the differential pressure channels at up to 5 kHz, accounting for every pressure pulse from an engine, from idle to maximum rpm. Standard output rate is 1 Hz.

Sample Handling: Sample probe, heated filter, coalescing filter and Nafion dryer are integrated into the tube electronics. An additional Nafion dryer is included in the FEM control module.

Embedded Calibration: Calibration coefficients embedded in the flow tube electronics are automatically recognized on connection. Therefore, tubes of varying sizes can be interchanged with one control module.

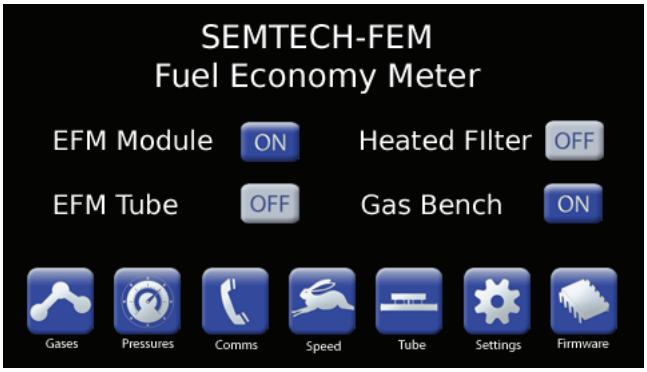
Multiple Tube Sizes: Eight flow tube sizes accommodate engines from less than 0.8L displacement up to 24L.

Back Purge: A software controlled back purge pump is included in the flow tube assembly, along with solenoids that route high pressure air backward through the pitot tube, purging contaminants and any condensation in the pressure lines. No dismantling is required.

Auto Zero: With a single software command, internal solenoids open the pressure sensors to ambient air, allowing fast and easy zeroing while the engine is still operating.

Graphical Panel Display: A full color, graphical touch screen displays live data and enables system set-up and basic functions, such as zero and span.

Power Supply Monitoring: Power can be either 12VDC, 110VAC, or 220VAC, with both current and voltage monitoring.



Graphical Touch Screen

1065 Compliant: The SEMTECH-FEM meets the EPA's 1065 compliance requirements for in-use testing.

Weatherproof Construction: The unit can be used in harsh environments, including for example, off-highway testing. All components meet IP54 (NEMA 3) standards.

Heated Components: The averaging pitot tube and pressure lines are heated at the flow tube assembly in order to prevent condensation and freezing in cold weather. The differential pressure sensors are housed in a temperature controlled manifold in the control module for added stability.

Design Details: Over a decade of experience with in-use emissions testing has gone into the design of the SEMTECH ECOSTAR system, including:

- EMI protection, including gaskets, filters and capped connectors
- Stress relief for pneumatic connections
- Channels for cable management
- Standard Swagelok bulkhead connectors
- Rugged Deutsch connectors for power and auxiliary connectors
- Handles that lock to other SEMTECH ECOSTAR modules for stable system integration

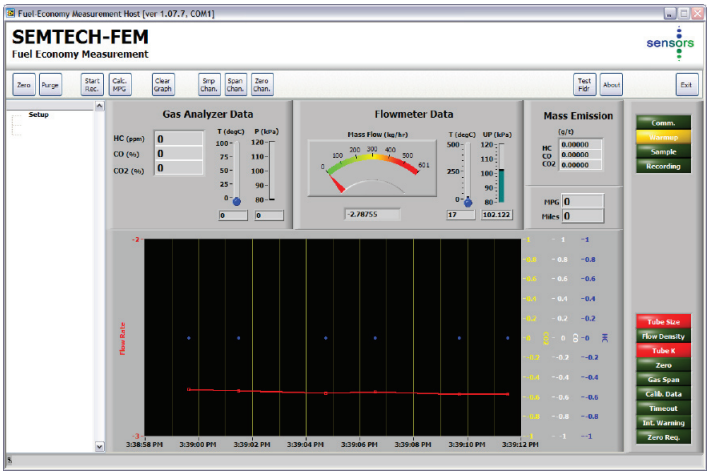
The Technology

Exhaust Flow

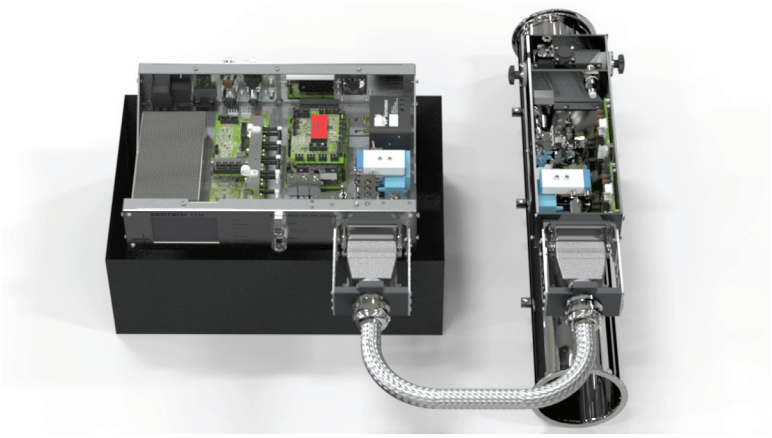
Operating under the Bernoulli principle, the SEMTECH-FEM uses four high-performance, dual-stage, differential pressure transducers, sampling continuously at up to 5 kHz, measuring every pressure pulse from an engine. The sensors are housed in a heated manifold, eliminating thermal drift. The eight combined differential pressure ranges span nearly five orders of magnitude, allowing accurate measurements over a wide range of flow rates. The smallest transducer range is 0.025kPa with a resolution of 5x105 kPa, while the highest range is 16.5 kPa.

Sample Handling and Gas Analysis

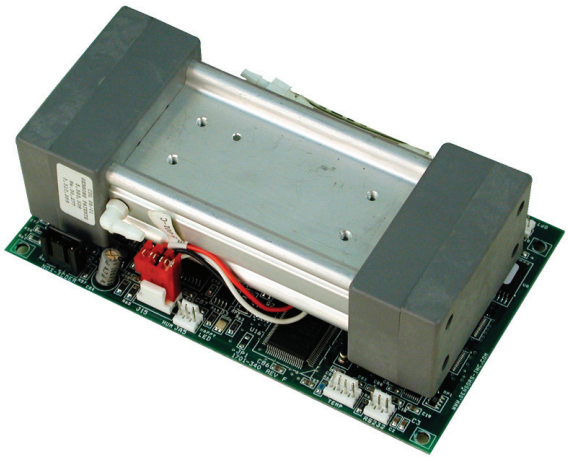
The exhaust sample is filtered and dried directly at the exhaust flow tube, with an additional dryer located in the control module. The intake manifold on the control module is custom built of stainless steel, to mitigate leaks. The gas analyzer uses NDIR technology, incorporating a heated sample cell and relative humidity sensor, along with the interface electronics and control electronics. Fuel economy is measured using the carbon balance method.



SEMTECH-FEM Host Software



Internal Packaging



Non-Dispersive Infra-Red gas analyzer measures CO, CO_2 and HC

User Support

As with all SEMTECH products, the Fuel Economy Meter comes with a widerange of customer support. Sensors' Remote Support, powered by WebEx, enables our trained technicians to view your SEMTECH unit in real-time to help answer your questions, diagnose issues, and evaluate data, without requiring any additional software. The customer portal contains a forum for users to share insights on the best practices for in-use emissions testing and to stay up to date with the latest software releases, manuals, technical service bulletins and tips and tricks of the trade.

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Available Tube Sizes and Flow Rates

Recommended Application: Engine Size (L) & Type								
Gas Diesel	< 1 † < 0.8	< 2 † < 1.5	< 2 < 1.5	2 - 5 1.5 - 4	> 5 4 - 6	- 6 - 12	- 12 - 18	- > 18
Flow Tube Outer Diameter								
in mm	1 25	1.5 38	2 51	2.5 64	3 76	4 102	5 127	6 152
Flow Tube Length (Length including extension)								
in mm	20 (26) 508 (660)	20 (26) 508 (660)	20 (26) 508 (660)	25 (32.5) 635 (825)	25 (34) 635 (864)	25 (37) 635 (940)	30 (45) 762 (1143)	36 (54) 914 (1372)
Backpressure	Flow rate at 200°C, SCFM (m^3/min)							
10" H_2O 2.5 kPa	67 (1.9)	109 (3.1)	175 (4.9)	425 (12.0)	600 (17.0)	1100 (31.2)	1700 (48.1)	2380 (67.3)
15" H_2O 3.75 kPa	83 (2.4)	146 (4.1)	215 (6.1)	550 (15.6)	775 (22.0)	1350 (38.2)	2100 (59.5)	2940 (83.3)
Backpressure	Flow rate at 400°C, SCFM (m^3/min)							
10" H_2O 2.5 kPa	56 (1.6)	91 (2.6)	147 (4.2)	356 (10.0)	503 (14.3)	922 (26.2)	1425 (40.3)	1995 (56.4)
15" H_2O 3.75 kPa	69.6 (2.0)	122 (3.5)	180 (5.1)	461 (13.1)	649 (18.4)	1132 (32.0)	1760 (49.9)	2465 (69.8)

† Non-Turbo

Exhaust temperature range:	-5 to 700°C standard construction (higher temperature capability available upon request)
Exhaust temperature accuracy:	± 1% of reading or ± 2°C, whichever is greater
Flow measurement linearity:	< 1.0% of full scale Exceeds 1065 Subpart D and ISO 16183 standards
Flow measurement accuracy*:	± 2% of reading or ± 0.5% of full scale, whichever is greater
Communications:	Ethernet, USB
OBDII Comms:	Serial
Control module dimensions:	43.6cm x 30.8cm x 9.1cm
Control module weight:	10 kg
Power:	12VDC, 110-220VAC, <100W

*As measured on calibration flow stand
** Optional paramagnetic O2 sensor

NOTE: Specifications are subject to change without notice. While due caution has been exercised in the production of this document, possible errors and omissions can occur.

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Gas Analyzer Specifications

Gas	CO	CO_2	O_2**
Range	0 - 8%	0 - 20%	0-25%
Resolution	10 ppm	0.01%	0.1%
Accuracy	±50 ppm or ±2% rdg	±0.1% or ±2% rdg	±2%rdg or 0.3%FS
Linearity	Intercept ≤ 0.5% range 0.990 ≤ Slope ≤ 1.01 SEE ≤ 1.0% range $R^2 \geq 0.998$		
Repeatability	±2% rdg or ± 20 ppm	±2% rdg or ± 0.05%	±0.1% O_2
Noise	± 20 ppm	±0.02%	±0.1% O_2
Span Drift (8hrs)	±2% of span or ± 20 ppm	±2% of span or ± 0.1%	<2% FS
Zero Drift (2hrs)	±0.005% (25 ppm)	±0.1%	<0.1% O_2
Response Time	T_{10-90} < 3.5s	T_{10-90} < 3.5s	T_{10-90} < 3.5s
Data Rate	1 Hz	1 Hz	1 Hz
Flow Rate (nominal)	2-3 lpm	2-3 lpm	0.2 lpm

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