

SMART 2000xfi

SMART 2000xfi module provides a mobile and portable instrumentation for raw exhaust gas flow and temperature measurements. That is synchronized with sample gas concentration and sample cell pressure and temperature measurements to provide mobile and portable exhaust gas mass measurements.

During emission testing all measured and calculated momentary values are placed in three dimensional data arrays in computer memory for the duration of the test. Test data is also displayed in CHART RECORDER graph format for visual analysis during testing. It can also be retrieved for historical chart displays or stored in MS EXCELL compatible data file.



SMART 2000xfi

SMART 2000 software provides utilities for saving each test into data files for further analysis and displays. When Mass Measurement switch is ON, following is the example of a sequence of the data columns in data files:

MASS O2 [g/km], MASS CO2 [g/km], MASS CO [g/km], MASS HC [g/km], MASS NOx [g/km], O2 [% vol.], CO2 [% vol.], CO [% vol.], HC [ppm.], NDIR Cell temp. [deg.C], Exh. Gas temp. [deg.C], Exh. gas flow [cfm], Average Exh. gas flow [cfm], Average MASS O2 [g/km], Average MASS CO2 [g/km], Average MASS CO [g/km], Average MASS HC [g/km], Average MASS NOx [g/km], Average Fuel Consumption[l/100 km], number of seconds from the beginning of the test [sec]. Data files have text format and can be imported to any standard data analysis software like Microsoft EXCEL.

Microsoft Excel - data_sample

1	O2	CO2	CO	HC	NDIR	O2	CO2	CO	HC	NDIR	Cell	Temp	Flow	Flow	O2	CO2	CO	HC	NDIR	Time	
2	kg/hr	kg/hr	kg/hr	kg/hr	kg/hr	%vol	%vol	%vol	ppm	ppm	ppm	deg.C	deg.C	cfm	cfm	kg/hr	kg/hr	kg/hr	kg/hr	kg/hr	seconds
3																					from test
4																					start
195	0.663734	12.7744	0	0.000282	0.077989	1.06	14.4	0	11	84	26.59	37.7	28.76189	33.7433	0.563189	15.21979	0.00574	0.00304	0.490653	174.601	
196	0.448603	17.2626	0.00743	0.000916	0.003303	0.76	14.7	0.01	11	76	26.59	36.9	30.37633	32.71626	0.563673	15.21979	0.005743	0.003045	0.484661	175.474	
197	0.586208	19.94939	0.006896	0.004007	0.104201	0.59	14.6	0.01	10	73	26.59	36.7	26.63611	33.67829	0.563797	15.257	0.005764	0.00305	0.486247	176.304	
198	0.636005	20.36186	0.012306	0.009727	0.145915	0.49	14.6	0.01	10	72	26.61	36.8	26.41434	33.64075	0.564491	15.32628	0.005802	0.003085	0.484466	177.156	
199	0.647636	41.22178	0.016182	0.006299	0.161461	0.61	14.5	0.02	10	162	26.59	36.8	26.93439	33.61054	0.564564	15.4463	0.005967	0.003094	0.484647	177.984	
200	0.945953	53.4913	0.026239	0.009878	1.683216	0.35	14.4	0.01	9	436	26.61	38.1	25.81264	33.5616	0.568082	15.67453	0.006462	0.00313	0.491004	178.837	
191	0.952733	55.19795	0.03181	0.011951	2.062962	0.32	14.4	0.01	9	601	26.61	38.4	25.29885	33.51971	0.570171	15.80851	0.006617	0.003172	0.502251	179.682	
192	0.704297	25.2442	0.01142	0.004769	1.011179	0.54	14.4	0.01	9	690	26.62	38.5	29.81933	33.49829	0.570989	15.91952	0.006788	0.003181	0.506068	180.522	
193	1.037484	13.50202	0.007321	0.002711	0.468889	1.24	12.1	0.01	8	388	26.62	38.1	48.31164	33.56171	0.57337	15.9583	0.006204	0.003178	0.504675	181.162	
194	2.388548	19.2676	0.010201	0.003789	0.84262	2.03	12.1	0.01	8	277	26.64	37.4	56.37899	33.67939	0.58288	15.96862	0.006225	0.003182	0.504466	182.207	
195	1.147534	12.18071	0.006188	0.001418	0.247959	2.96	12.7	0.01	8	215	26.64	38.2	102.8399	34.02415	0.588462	15.94944	0.006225	0.003172	0.505214	183.045	
196	1.495183	13.35846	0	0.001678	0.183227	2.17	14.1	0	8	185	26.64	38.2	126.5601	34.47959	0.593209	15.93447	0.006192	0.003184	0.501465	183.884	
197	1.116465	12.5424	0	0.001576	0.164214	1.73	14.1	0	6	166	26.64	38.9	105.2355	34.82063	0.595945	15.91776	0.00616	0.003186	0.498556	184.725	
198	0.830645	12.59884	0	0.001823	0.172522	1.28	14.2	0	7	149	26.64	37.1	124.8874	35.27198	0.597109	15.90014	0.006128	0.003149	0.497779	185.573	
199	0.539392	12.32798	0	0.001797	0.119904	0.94	14.2	0	7	132	26.64	37.6	52.6393	35.45631	0.597093	15.88178	0.006096	0.003142	0.495031	186.422	
200	0.452218	12.22087	0	0.001762	0.104477	0.83	14.2	0	7	116	26.65	37.6	62.3263	35.59439	0.598248	15.86077	0.006065	0.003125	0.492624	187.268	
201	0.526115	12.09895	0	0.001795	0.098461	0.53	14.3	0	7	100	26.65	37.9	79.44191	35.80784	0.594807	15.84387	0.006034	0.003128	0.491756	188.106	
202	0.303124	13.68088	0	0.002291	0.097148	0.43	14.3	0	6	86	26.67	37.9	89.81839	36.1161	0.593389	15.8328	0.006004	0.003124	0.489702	188.953	
203	0.415880	22.10112	0	0.002653	0.116574	0.37	14.3	0	6	74	26.67	37.9	80.83795	36.37748	0.592462	15.80546	0.005973	0.003123	0.487633	189.791	
204	0.442565	27.19395	0	0.004495	0.132302	0.32	14.3	0	8	67	26.68	38.3	106.1245	36.7112	0.591739	15.82228	0.005943	0.003134	0.486851	190.638	
205	0.637486	49.80442	0	0.010132	0.282891	0.28	14.3	0	10	79	26.68	41.1	111.2509	37.08663	0.592268	16.08747	0.005914	0.003169	0.489505	191.473	
206	0.781099	59.82332	0	0.015281	0.400044	0.25	14.3	0	10	82	26.68	40.9	122.3409	37.47027	0.593112	16.20576	0.005884	0.003214	0.484627	192.314	
207	0.688737	60.18636	0	0.011884	0.367946	0.22	14.4	0	11	84	26.67	41.1	123.2039	37.87518	0.593488	16.22289	0.005895	0.003266	0.484045	193.159	
208	0.727504	60.01989	0	0.012546	0.278977	0.24	14.4	0	11	84	26.67	41.3	123.2334	38.27932	0.594146	16.73726	0.005826	0.003316	0.483034	194.016	
209	0.879582	24.27078	0.003978	0.006226	0.88418	0.45	12.6	0.03	12	47	26.68	42	123.8628	38.67211	0.594095	16.74749	0.005862	0.003331	0.481508	194.862	
210	1.083288	29.36701	0.040268	0.007545	0.777887	0.7	13.8	0.03	12	35	26.68	42.4	122.83	39.06395	0.594442	16.83662	0.006131	0.003351	0.479123	195.688	
211	1.504607	37.26225	0.00816	0.0094	0.074859	0.78	14.1	0.03	12	27	26.7	41.1	41.93196	39.07063	0.600048	16.83536	0.006247	0.003381	0.477161	196.514	
212	1.181111	46.9771	0.06247	0.011927	0.799462	0.71	14.1	0.03	12	23	26.7	40.6	69.99494	39.17048	0.600298	17.00001	0.006251	0.003421	0.476242	197.362	
213	1.251846	43.1821	0.019217	0.010707	0.686288	0.57	14.3	0.01	12	21	26.7	40.3	68.14878	39.28424	0.600342	17.2095	0.006484	0.003456	0.473276	198.207	
214	1.133376	50.4472	0.022539	0.005257	0.695164	0.44	14.3	0.01	12	23	26.69	40.6	63.90904	39.4944	0.611095	17.38551	0.006676	0.0035	0.471419	199.063	
215	0.881894	55.51582	0.024849	0.011376	0.194889	0.33	14.4	0.01	12	27	26.7	40.8	67.78031	39.65833	0.611193	17.57365	0.00684	0.003546	0.469673	199.902	
216	0.772059	59.29528	0.025863	0.014476	0.115282	0.28	14.4	0.01	12	27	26.71	40.8	63.99844	39.85448	0.612938	17.72318	0.006831	0.003589	0.467904	200.756	
217	0.627865	59.21004	0	0.014978	0.101169	0.21	14.4	0	12	24	26.72	41.1	70.84844	39.99235	0.614002	17.82893	0.006899	0.003649	0.466273	201.588	
218	0.477993	59.15169	0	0.014864	0.073006	0.16	14.4	0	12	17	26.71	41	36.63951	40.02982	0.613014	18.01443	0.006834	0.003751	0.462608	202.372	
219	0.536239	59.05031	0	0.014954	0.042326	0.16	14.4	0	12	15	26.72	42.7	41.63999	40.03686	0.612688	18.20329	0.006862	0.003802	0.460605	203.159	
220	0.293183	19.73932	0.04423	0.004929	0.003346	0.29	14.2	0.05	12	14	26.74	41.9	28.28157	39.98405	0.611179	18.09582	0.006875	0.003807	0.458766	204.963	
221	0.222663	29.27225	0.062382	0.007889	0.027961	0.43	14.2	0.05	12	13	26.72	42.1	28.28162	39.93241	0.611232	18.95482	0.007235	0.003822	0.459776	206.813	
222	0.764614	31.68328	0.070243	0.007927	0.027986	0.47	14.3	0.05	12	12	26.74	42.2	28.18289	39.90795	0.611189	18.91422	0.007074	0.003884	0.454468	208.645	
223	0.54284	31.68328	0.082833	0.008363	0.038398	0.44	14.3	0.05	13	13	26.74	43.1	28.18289	39.90795	0.611189	18.91422	0.007074	0.003884	0.454468	209.487	

SMART 2000 EXHAUST ANALYZER

Test Display Service Print

08-03-2000 20:29:12

O2 **0.02** kg/hr

CO2 **14.4** %

CO **0.15** kg/hr

HC **0.45** kg/hr

NOx **0.097** kg/hr

A/F RATIO **14.7**

OL **0.4**

RPM **1**

MASS UNITS
AVERAGES TOTALS

SYSTEM STATUS

- Communication: normal
- Procedure: measurement
- Test mode: check wiring
- Self check: normal
- Warning: normal

DETAILS

The cumulative and averaged mass values are calculated automatically and displayed in NUMERIC screen.

SMART 2000xf1

SPECIFICATIONS

Measuring Ranges	Accuracy/Performance
Exhaust Gas flow range 0 - 120 cfm - Engines up to 3000 cc 0 - 450 cfm - Engines up to 12000 cc	+/- 0.5 % Absolute
Exhaust Gas. Temp. 0-700 Deg. C. J Type Thermocouple	+/- .5% Absolute
Exhaust Gas Pressure Diff. Sensor 0 - 12 " H ₂ O, +/- 1000 mV	14 bits
CO: g/min, g/km, g/bhp-h, g/kWh CO ₂ : g/min, g/km, g/bhp-h, g/kWh HC: g/min, g/km, g/bhp-h, g/kWh O ₂ : g/min, g/km, g/bhp-h, g/kWh NOx: g/min, g/km, g/bhp-h, g/kWh	+/- 3.5% of Reading +/- 3.5% of Reading +/- 3.5% of Reading +/- 3.5% of Reading +/- 5% of Reading

Environment	
Temperature	10 - 50 Deg. C.
Gas Pressure	0- 12 in. H ₂ O
Humidity	95%

General	
Response Time	Less than 100 msec
Warm Up Time	1 min.
Power	12 VDC , Max. 1 Watt

Dimensions/Weight	
Flow Sensor	18" x 4" dia – heavy duty / 7.4 lb 12" x 2" dia – passenger / 3.0 lb

SPECIFICATIONS:

DRS1000 VEHICLE GROUND SPEED SENSOR

Measuring Ranges	Accuracy/Performance
Vehicle speed range 0 - 300 mph Max. target distance 1000 ft	+/- 0.36 % Absolute +/- .25% Absolute
Output: 0 5 square wave, 211.6 Hz/mph	

Environment	
Temperature	-17 - 60 Deg. C.
Humidity	98%

General	
Response Time	Less than 50 msec
Warm Up Time	.5 min.
Power	12 VDC , Max. 4 Watt

Dimensions/Weight	
Speed sensor	4.175" x 2.0"dia, 0.5 Lb
Mounting bracket	8" x 2 " x 1.5", 1.7 lb.

SMART 2000dil module

Portable dilution system eliminates sample water condensation related problems and measuring errors during exhaust gas analysis.

SMART 2000dil module is incorporated into SMART 2000xfl mass emission module where sample gas and dilution gas are being mixed at high temperature of the exhaust gas stream. Dilution gas (typically air) is drawn into unique channels inside the SMART 2000xfl module body, heated up and then mixed with the exhaust gas sample in user selected ratio. Dilution ratio coefficient can be entered into SMART 2000 software for real time recalculation of the actual exhaust gas concentrations.

SMART 2000dil module sets up a new standard of reliability and accuracy in portable tail pipe mass emission measurements. When combined with SMART 2000 series analyzers and modules it delivers laboratory grade capabilities in real life driving test cycles.



SPECIFICATIONS

Measuring Ranges	Accuracy/Performance
Exhaust Gas Sample Flow range: 0 - 1 lpm Air flow range: 0 - 5 lpm	+/- .5% +/- .25%
ResponseTime (flow, temperature)	Less than 30 msec.
Dilution Ratio : 5:1 to 1:1 Warm Up Time: 1 min.	
Exhaust Gas Temperature 0-700 Deg. C. (J Type Thermomcouple)	+/- .5%
Sampling hose 3/8" up to 35' length	
Exhaust Gas Pressure Sensor 0 -18" H2O, 1000mV	14 bits
Control Computer : Pentium Based Notebook for SMART 2000	
Power: 12 VDC 50 mA Dilution Ratio Regulation 3/8" Flow Valve	

Environment	
Temperature	10 - 50 Deg. C.
Gas Pressure	0- 20 in. H2O
Humidity	98%