1730 Series Oxygen Transmitter Probe Simulator

The 1730 series probe simulator is an electronic signal generator used by service technicians to test transmitter hardware and to diagnose hardware faults.

The simulator attaches to a *Novatech 1730 series transmitter* in place of the two zirconia probes and can simulate thermocouple inputs, probe oxygen levels and sensor high impedance conditions.

The probe simulator is used to isolate faults in the probe and attached wiring, or the transmitter hardware itself. It can accurately generate any oxygen level required for calibrating the analog
4-20mA links to re-transmit process variables back to a control room.

The probe simulator is powered from the transmitter and does not require an internal battery. Both oxygen probe inputs has their own individual set of controls with 10 turn potentiometers to adjust sensor temperature and sensor EMF.

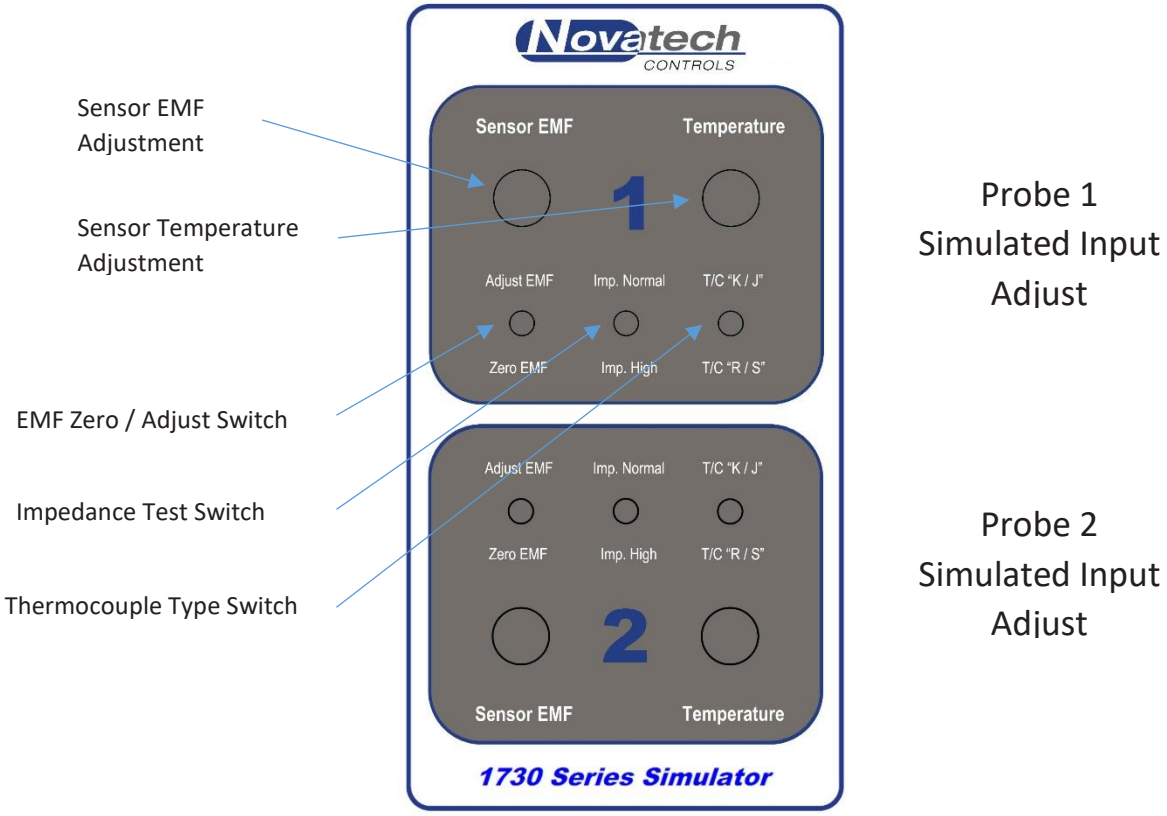
Before connecting the 1730 series probe simulator, please read the warnings below

1. If the oxygen transmitter is being used for control of a combustion appliance or feedback control loop, make sure that the appliance is left in a safe state while the transmitter is being tested. Failure to do so may lead to damage to any connected appliances.

2. If the transmitter is running a heated probe, please disconnect all heater outputs and remove the burner interlock input link before connecting the simulator box. Failure to do so may lead to damage to the probes.

Simulator Controls

The simulator box has two identical sets of controls for each of the two oxygen probe inputs. The controls consist of two potentiometers for adjusting the sensor temperature and sensor output EMF, and three switches. The three switches are used to configure the test box.



Sensor EMF Adjustment

Use this potentiometer to adjust the simulated sensor EMF, from -55mV to 1350mV. To use this adjustment, the *EMF Zero / Adjust Switch* must be set in the 'Adjust EMF' position

Sensor Temperature Adjustment

Use this potentiometer to adjust the simulated sensor temperature.

EMF Zero / Adjust Switch

Quickly switch between adjustable EMF input and zero EMF for the simulated sensor EMF output

Impedance Test Switch

Used for testing the impedance checking circuitry of the transmitter. With this switch set to 'Imp Normal' the transmitter should measure a sensor impedance of ~0.5kΩ, and with the switch set to 'Imp High' it should measure ~10kΩ

Note: Refer to the transmitter technical manual on how to manually test sensor impedance.

Thermocouple Type Switch

Switch between K-Type thermocouples used in 1231 heated probes and R-Type thermocouples used in 1232 unheated probes

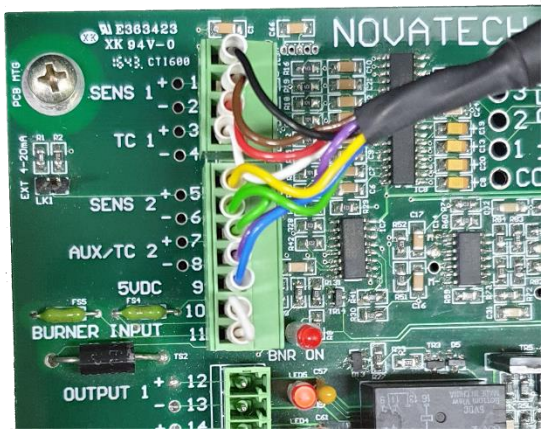
How to Use the Probe Simulator

Connecting the Probe Simulator

- Open the door of the transmitter. Locate the probe 1 and probe 2 input connectors at the top-left of the main PCB (terminals numbered 1 to 11) and the heater power output connectors (terminals 41 to 44) at the top right corner of the main PCB.

- Disconnect all of the above terminals. If the system only uses a single probe then you will only have to disconnect two connectors. If the system has dual probes then you will need to disconnect all four connectors.

Note: Make a note of any wiring disconnected and ensure that the plugs are returned to the same connections after testing.



- Connect both the 4-way and the 7-way connectors from the probe signal box to terminals 1 to 11 on the top-left inputs on the main PCB.

For transmitters configured for single probe use, it is important to plug in both the 4-way connector for probe 1 and the 7-way connector to the probe 2 otherwise the simulator will not work.

Setting the Simulated Oxygen Level

The simulated oxygen level displayed on the transmitter will depend on both the sensor temperature and sensor EMF settings on the simulator. Ensure that the thermocouple type switch is set to the correct position for the probe to be simulated, it should be the same thermocouple as that configured in the Commissioning Menu on the transmitter.

Note: Most 1231 heated probes have a K-type thermocouple, while most 1232 unheated probes have an R-type thermocouple.

If the transmitter is powered off, switch on the transmitter and adjust the temperature and EMF controls to the levels expected for normal operation. Calculation of oxygen and other related process variables will not occur until the sensor temperature is >550°C. Normal operating temperature for a 1231 heated probe is 720°C.

See the following two pages for tables showing calculated oxygen values and the corresponding sensor EMF input.

Testing the 4-20mA Output Channels

The 4-20mA analog output channels will remain in a ‘parked’ state until the sensor temperature for the affected process variable is >600°C. While testing the analog outputs it is recommended that the sensor temperature be set to the normal operating temperature for the process, or 720°C for a 1231 heated probe.

Refer to the transmitter technical manual for the 1730 device for information on calibrating the analog 4-20mA outputs, and for setting the output process variable and scale range.

ZIRCONIA OXYGEN SENSOR OUTPUT (mV)
PROBE TYPE 1231, SENSOR TYPE 1234

OXYGEN %	Probe EMF @ 720°C (1320°F)	OXYGEN %	Probe EMF @ 720°C (1320°F)
20.95	0	10.0	15.930
20.5	0.517	9.5	17.033
20.0	1.046	9.0	18.196
19.5	1.589	8.5	19.426
19.0	2.147	8.0	20.730
18.5	2.719	7.5	22.120
18.0	3.306	7.0	23.607
17.5	3.911	6.5	25.204
17.0	4.533	6.0	26.930
16.5	5.173	5.5	28.808
16.0	5.834	5.0	30.867
15.5	6.515	4.5	33.145
15.0	7.219	4.0	35.695
14.5	7.947	3.5	38.590
14.0	8.700	3.0	41.940
13.5	9.481	2.5	45.913
13.0	10.292	2.0	50.797
12.5	11.134	1.5	57.135
12.0	12.011	0.9	66.182
11.5	12.925	0.4	82.168
11.0	13.881	0.2	99.518
10.5	14.881	0.1	114.347

'K' Type TC 29.965 mV @ 720°C (1320°F)

These tables are based on the Nernst equation:

$$EMF = \frac{T}{46.421} \times \log_e \left(\frac{20.95}{O_2} \right)$$ Where *T* is the probe temperature °K

ZIRCONIA OXYGEN PROBE OUTPUT (mV)
PROBE TYPE 1232

	TEMPERATURE °C (°F)								
OXYGEN %	**600 (1110)**	**700 (1290)**	**800 (1470)**	**900 (1650)**	**1000 (1830)**	**1100 (2010)**	**1200 (2190)**	**1300 (2370)**	**1400 (2550)**
20	0.873	0.973	1.073	1.173	1.273	1.373	1.473	1.573	1.673
19.5	1.349	1.504	1.658	1.813	1.967	2.122	2.276	2.431	2.585
19	1.838	2.048	2.259	2.469	2.680	2.890	3.100	3.311	3.521
18.5	2.339	2.607	2.875	3.143	3.411	3.679	3.947	4.215	4.483
18	2.855	3.182	3.509	3.835	4.162	4.489	4.816	5.143	5.470
17.5	3.385	3.772	4.160	4.547	4.935	5.323	5.710	6.098	6.485
17	3.930	4.380	4.830	5.280	5.730	6.180	6.630	7.080	7.530
16.5	4.491	5.006	5.520	6.034	6.549	7.063	7.578	8.092	8.606
16	5.070	5.651	6.231	6.812	7.393	7.973	8.554	9.135	9.715
15.5	5.667	6.316	6.965	7.614	8.263	8.913	9.562	10.211	10.860
15	6.284	7.004	7.723	8.443	9.163	9.882	10.602	11.322	12.042
14.5	6.922	7.714	8.507	9.300	10.093	10.885	11.678	12.471	13.263
14	7.582	8.450	9.318	10.187	11.055	11.923	12.792	13.660	14.528
13.5	8.266	9.212	10.159	11.106	12.052	12.999	13.946	14.892	15.839
13	8.976	10.004	11.032	12.060	13.087	14.115	15.143	16.171	17.199
12.5	9.713	10.826	11.938	13.051	14.163	15.276	16.388	17.500	18.613
12	10.481	11.682	12.882	14.082	15.283	16.483	17.684	18.884	20.084
11.5	11.282	12.574	13.866	15.158	16.450	17.742	19.034	20.326	21.618
11	12.118	13.506	14.893	16.281	17.669	19.057	20.445	21.833	23.220
10.5	12.993	14.481	15.969	17.457	18.945	20.433	21.921	23.409	24.897
10	13.911	15.504	17.097	18.690	20.283	21.876	23.469	25.063	26.656
9.5	14.875	16.579	18.283	19.986	21.690	23.394	25.097	26.801	28.504
9	15.892	17.712	19.533	21.353	23.173	24.993	26.813	28.633	30.453
8.5	16.967	18.911	20.854	22.797	24.740	26.684	28.627	30.570	32.513
8	18.108	20.182	22.255	24.329	26.403	28.477	30.551	32.625	34.698
7.5	19.322	21.535	23.747	25.960	28.173	30.386	32.599	34.812	37.025
7	20.619	22.981	25.342	27.704	30.065	32.427	34.788	37.150	39.511
6.5	22.013	24.534	27.056	29.577	32.098	34.619	37.140	39.661	42.182
6	23.519	26.212	28.906	31.600	34.293	36.987	39.680	42.374	45.067
5.5	25.155	28.036	30.917	33.798	36.679	39.560	42.442	45.323	48.204
5	26.948	30.035	33.121	36.207	39.293	42.380	45.466	48.552	51.639
4.5	28.930	32.243	35.557	38.870	42.183	45.496	48.810	52.123	55.436
4	31.145	34.712	38.279	41.846	45.413	48.980	52.547	56.115	59.682
3.5	33.657	37.512	41.366	45.221	49.076	52.930	56.785	60.640	64.494
3	36.557	40.743	44.930	49.117	53.303	57.490	61.677	65.864	70.050
2.5	39.986	44.565	49.145	53.724	58.304	62.883	67.463	72.042	76.622
2	44.183	49.243	54.303	59.364	64.424	69.484	74.544	79.604	84.665
1.5	49.594	55.274	60.954	66.634	72.314	77.994	83.674	89.354	95.034
1	57.221	63.774	70.327	76.881	83.434	89.988	96.541	103.094	109.648
0.5	70.258	78.305	86.351	94.398	102.445	110.491	118.538	126.584	134.631
0.2	87.493	97.514	107.534	117.554	127.575	137.595	147.616	157.636	167.657
Thermocouple mV									
'K' Type	24.905	29.129	33.275	37.326	41.276	45.119	48.838	52.410	-
'J' Type	33.102	39.132	45.494	51.877	57.953	63.792	69.553	-	-
'R' Type	5.583	6.743	7.950	9.205	10.506	11.850	13.228	14.629	16.040
'S' Type	5.239	6.275	7.345	8.449	9.587	10.757	11.951	13.159	14.373
'N' Type	20.613	24.527	28.455	32.371	36.256	40.087	43.846	47.513	-

These tables are based on the Nernst equation:

$$EMF = \frac{T}{46.421} \times \log_e\left(\frac{20.95}{O_2}\right)$$ Where *T* is the probe temperature °K

Thermocouple information from NIST ITS-90 data tables