Teledyne Electronic Devices

Model 200T

Oxygen Monitor

Service Manual

P/N SMC41901.02
12/91

Table of Contents

This manual is intended to provide information to help qualified maintenance personnel service and repair the TED Model 200T oxygen monitor. The ability to read and follow schematics is assumed, as is basic electronic knowledge of the functions and characteristics of operational amplifiers.

The only equipment needed to service the monitor is a digital voltmeter; however, you may find that a means of simulating the sensor is useful in troubleshooting. A schematic for a simple cell simulator circuit is provided on page 6.

Description of the TED 200T

The TED 200T uses a galvanic fuel cell sensor to detect the oxygen level in the gas immediately surrounding the tip of the sensor. The sensor signal is processed and displayed as a percentage.

Sensor

The T–7 Micro-Fuel Cell puts out a minute current in proportion to the partial pressure of the oxygen in the gas surrounding the sensor. The current is zero at zero oxygen pressure and is a maximum at 100% oxygen.

Alarms

The two alarms are set through the touch panel. The HI alarm can be set anywhere from 21 to 100, or OFF. The LO alarm can be set from 17 to 99. There is an alarm test option as well as an alarm silence key, which defeats the audible/visible alarm in increments of 30, 90, and 180 seconds.

Alarms

Display and Touch Panel

The display is a digital liquid crystal display (LCD) showing oxygen level in percent.

All functions are microprocessor-controlled. Commands are input through the touch panel and processed in a one-time programmable ROM chip residing on the controller PC board. The LCD is driven by two ICs on the display and timing board.

Circuit Description

The three circuits in the TED 200T are shown in schematics B-41912 (Analog board), B-41913 (Controller), and B-41914 (Display and Timing).

Sensor

The current output from the sensor is affected by the temperature of the gas the sensor is immersed in. To compensate for this, the first stage of the amplifier circuit varies the gain of the amplifier according to input from the temperature-sensitive resistor (thermistor) mounted in the sensor housing.

The thermistor output is placed into the negative feedback loop of U5. This amplifier converts the non-compensated cell current into a temperature-compensated voltage, which is further amplified by U6. This amplified voltage drives the calibration potentiometer, which in turn drives the LCD display.

The current output from the sensor leaves the RFI shielding through the black lead; temperature control through the red; and common, green.

Reference Voltage

Two reference voltages are required in order to precisely set the dynamic range of the analog-to-digital converter. These reference voltages are generated by U2 and U4.

Alarm Circuit

The analog-to-digital converter reads the voltage at the output of the sensor amplification circuit and sends it to the microprocessor, which uses the information input by the user to calculate which voltages from the sensor amplification circuit should trigger an alarm.

The microprocessor also receives the battery voltage, after the voltage has been divided by a resistor ladder and converted by the analog-to-digital converter, and activates the low battery indicator if the voltage is below a predetermined level.

A logic circuit in the microprocessor allows the alarm buzzer (but not the LED) to be bypassed in increments of 30, 90 and 180 seconds. A similar logic circuit enables alarm testing.

Display

The LCD is driven by driver chips which receive data from the microprocessor. The auxiliary messages (HI alarm, LO alarm, and low battery) on the LCD are driven by "exclusive or" gates in a separate IC and are enabled by a "high" to the appropriate line.

Power Supply

The TED 200T uses 4 "AA" alkaline batteries which provide 6 volts and a ground. An integrated circuit chip regulates this voltage to 4.61 volts.

Repair/Replacement

Battery Replacement

1. Turn the instrument off.
2. Open the battery compartment door from left to right.
3. Remove the battery holder and take out the old batteries (if any).
4. Install 4 "AA" **alkaline** batteries (other types of batteries will give erroneous battery test readings) into the holder, observing proper polarity.
5. Snap the battery holder back onto the leads and slide the holder back into the compartment.
6. Close the compartment door.

T–7 Sensor Replacement

1. Turn off the instrument.
2. Unplug the coiled cable from the old sensor.
3. Remove the new sensor from its protective plastic bag.
4. Plug the coiled cable into the new sensor and calibrate.

Opening the Case

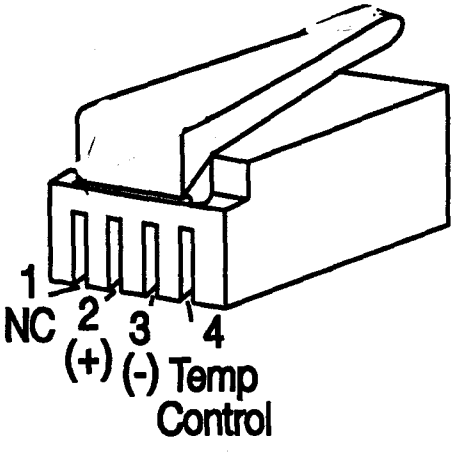
1. Turn the instrument off
2. On the bottom of the unit are four rubber bumper feet. Remove the screw in the center of each foot.
3. Carefully lift off the cover. If desired, turn the unit over, holding the two case halves together, and remove the top cover.

To close the instrument, reverse this procedure, being careful not to pinch any wires between the halves of the case.

Sensor Simulator

Occasionally, it is necessary to simulate a sensor for testing. The sensor connector and simulator are wired as shown below.

The sensor simulator shown will only give a general indication that the TED 200T electronic circuitry is operating normally. Actual calibrations should be in air with the sensor attached.



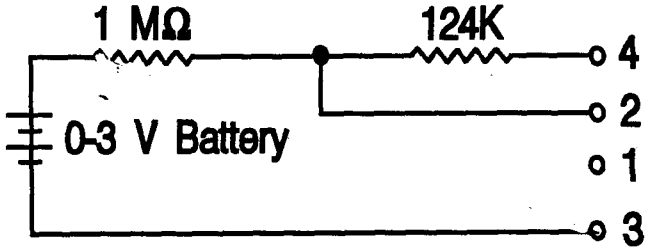


Figure 1a & 1b: the sensor simulator circuit.

Modifying the TED 200 to the 200T:

The TED 200 with the J–1 sensor can be updated to the TED 200T, which uses the T–7 Micro-Fuel Cell. Contact Teledyne Electronic Devices for further information.

Troubleshooting

Blank LCD when turned on	a) Low battery: replace battery. b) Open casing and check battery wires. Replace with P/N B56 if necessary. Retest.
LCD reads 1 when turned on	a) Check LCD pin #7 with ohmmeter. Meter should read 0 volts.
LCD reads 00 when turned on	a) Install sensor simulator. If it still reads 00, check coiled sensor cable contacts at the PC board. Resolder if necessary. b) If the wiring is intact, replace the cable.
LCD reads 1 continuously	a) Check yellow thermistor wire contact at the board. Resolder if necessary. b) If the connection is intact, replace the cable.
Malfunctioning LCD segments	a) Remove display and timing boards from case. If this solves the problem, solder mask has come off the board traces. Cover the edges of the board with tape to isolate the traces. b) Clean LCD contacts with alcohol. c) Replace LCD. d) If the problem persists, replace 28-pin DIPS.
Instrument cannot be calibrated	a) If the display reads <13 or >33% and cannot be calibrated, sensor needs replacing. b) With the batteries connected, check for 3.66 V at both pins 2 and 3 of U5 on the analog board (the board closest to the battery compartment). Anything less indicates that there is a short in the amplifier circuit. Check for solder bridges and jumper wires that short against resistor wires. c) Unsolder the green, red and black wires from the feedthrough capacitors, and check voltages at pins 2 and 3 of U5. A voltage of 3.66 indicates that the feedthrough caps are heat damaged. Replace entire shield box along with caps.

The unit will not calibrate	a) Measure the RFI feedthrough capacitor isolation to ground with an ohmmeter by connecting one lead to the brass shield and the other to the suspect RFI capacitor. Reading should be < 1 nS on the nano-Seimens scale. b) Check phone jack solder connections underneath the brass shield. Unsolder the shield and clean the circuit board with alcohol. Check for shorts.
Keyboard not responding	a) Check 14-pin DIPS on the controller board for bent pins. b) Replace keyboard.
Unit emits faint, steady tone or beeping	a) Tack a 10K Ω resistor from the base of Q2 to ground on the controller card.

Test Procedures

(Controller or Display Board):

1.0 **Equipment required:** Functioning TED 200T analog PC board
Functioning TED 200T keyboard
Variable power supply 0-6 VDC
Variable power supply 0-3 VDC
3 jumpers, 10 " long

2.0 **Set-Up**

a) Set the 0-6 VDC power supply to 6 volt ±1%, and connect it to the battery clip of the analog PC board.

b) Connect the sensor simulator to the shield box terminals as shown in Figure 1b on page 6. Connect terminal
#4 to the red wire of the analog PC board.
#3 to the black wire of the analog PC board.
#2 to the green wire of the analog PC board.

3.0 **ON/OFF**

a) Turn on the 0-6 VDC power supply.

b) Press the ON/OFF key once. This key should click audibly (as should all subsequent key depressions) and the LCD should display the high and low alarm set points of 100 and 17 respectively. The LCD should also flash the message AIR CAL at a rate of 1 Hz.

4.0 **Calibration Min 21% and 100%**

a) Adjust the 0-3 VDC power supply to 0.49 V.

b) Press the CAL key once. The unit should count down from 10 to 1 at a 1 Hz rate and then display 21. The message CAL IN 100% should flash at a 1 Hz rate for 5 seconds.

c) Turn the 0-3 VDC power supply to 1.429 V.

d) Push the CAL key twice. The unit should count down from 15 to 1 at a 1 Hz rate and then display 100. The message CAL IN 100% should flash at a 1 Hz rate for 5 seconds. The HI ALARM and red LED should flash.

5.0 **Calibration Max 21% and 100%**

a) Adjust the 0-3 VDC power supply to 0.495 V. Press the CAL key once. The unit should count down from 10 to 1 at a 1 Hz rate and then display 21. The message CAL IN 100% should flash at a 1 Hz rate for 5 seconds.

b) Set the 0-3 VDC power supply to 2.37 V.

c) Push the CAL key twice. The unit should count down from 15 to 1 at a 1 Hz rate and then display 100. The message CAL IN 100% should flash at a 1 Hz rate for 5 seconds. The HI ALARM and red LED should flash.

d) Turn the 0-3 VDC power supply to 0.495 V.

6.0 **Battery Test**

Push the BATT TEST key. The unit should display the message BATTERY HOURS LEFT 999 for 5 seconds.

7.0 **Low Battery Test**

a) Turn the 0-6 VDC power supply to 5.4 V. LO BAT should display.

b) Turn the 0-6 VDC power supply to 6.0 V.

8.0 **Alarm Test**

a) Press the SET HI ALARM key, and then verify that the alarm point can be adjusted by depressing the "Up" and "Down" arrow keys.

b) Press the ALARM TEST key twice. Verify that the LCD counts up from 21 to the high alarm set point, sounds the beeper and blinks the LED, and then counts back down to the low alarm set point, sounds the beeper, and blinks the LED.

c) With the LCD reading 21%, set the low alarm to some value above 21. The alarm should sound and the LED should flash. Now verify that the ALARM SILENCE key is working by hitting this key once. About 5 seconds after striking this key, the LCD should begin counting down from 30 to 1 in the lower right-hand corner of the display. While the LED should continue to flash, the beeper should not beep while the machine is counting down from 30.

9.0 **Watchdog Timer**

a) Verify that the watchdog timer circuit is functioning by removing the jumper in a socket on the display and timing board during normal operation (i.e., displaying O_2 concentration).

b) Tie pin 8 of the socket to ground. After about 5 to 15 seconds after removal of the jumper, the LCD should go blank. The beeper should sound continuously, and the LED should light and remain lit indefinitely.

c) After this test is complete, remove the ground connection made at pin 8 of the socket and reinsert the jumper. Turn the switch to OFF and remove the PC board.

(Analog PC Board)

1.0 **Equipment required:** Variable power supply 0-6 VDC
Variable power supply 0-3 VDC
DMM
Small flathead screwdriver
3 jumpers, 10 " long
100 KW resistor

2.0 **Set-Up**

3 jumpers, 10 " long

b) Turn the 0-6 VDC power supply to 6 volt ±1%. Connect the 0-6 VDC power supply to the battery clip of the analog PC board.

3.0 **Power Supply**

a) Turn on the 0-6 VDC power supply.

b) Checking U7 pin 7 and U1 pin 8 with reference to ground (J1-2 is ground) should give voltage reading of 6 V.

c) Check U1 pin 5. Voltage should be less than 0.5 V.

d) Check J1 pin 11. Voltage should be 4.61 VDC. Do not remove any jumpers at this point.

4.0 **Zero Adjustment**

a) Check J1 pin 6. Voltage should be 3.65 V±3%.

b) Check J1 pin 7. Voltage should be .900 V±3%.

c) Connect the DVM negative lead to J1 pin 6 and positive lead to J1 pin 5, and then adjust P1 on the analog PC board until the DVM reads +5.55 mVDC±.5mVDC.

d) Turn off the 0-6 VDC power supply.

5.0 21% and 100% Output Voltage

a) Connect the sensor simulator to the shield box terminal as shown in Figure 1b on page 6.

b) Connect terminal
   #4 to the red wire of the analog PC board.
   #3 to the black wire of the analog PC board.
   #2 to the green wire of the analog PC board.

c) Connect the negative DVM lead to J1 pin 6. Connect the positive DVM lead to J1 pin 5.

d) Turn the 0-3 VDC variable power supply to 0.200 VDC. Voltage should be .273 VDC. Do not remove any jumpers at this point.

should be 2.18 VDC

e) Set the 0-3 VDC variable power supply to 2.37 VDC. Voltage should be 2.18 VDC.

6.0 Battery Test and Battery Level

a) Connect the 10 KW resistor between pin 1 and 2 of the J1 header.

b) Connect the negative DVM lead to J1 pin 2 and the positive DVM lead to J1 pin 8. Voltage should be 2.930 VDC ±3%.

7.0 Low Battery Test

a) Connect the voltmeter to J1 pin 11.

b) Turn the 0-6 VDC power supply to 5 V. The voltmeter should read 0.0 VDC.

c) Turn the 0-6 VDC power supply to 6 V.

8.0 Current Check

a) Turn off power supply. Make sure that the jumper from 2.0a and the resistor from 6.0a, above, are connected.

b) Remove power from the battery clip. Connect the ammeter in series with the power supply in the current-measuring mode.

c) Turn on power supply. Current should be less than 1.6 mA.

d) Turn off power supply and remove all jumper connections.

Specifications

Range:	0-100% oxygen
Accuracy:	(after 2-point calibration) ±2% of full scale for 8 hours at constant temperature
Response Time:	90% in less than 10 seconds (typically 4–6 sec.)
Display Resolution:	Nearest whole number
Calibration Time:	@ 21%: 10 sec. @ 100%: 15 sec.
Battery Life:	Approximately 1,000 hrs. continuous use in non-alarm conditions using 4 "AA" alkaline batteries.
Humidity Range:	0–95% RH
Expected Sensor Life:	1 year in most applications
Sensor Type:	Class T-7 (Galvanic)
Dimensions:	7"W x 5"D x 2-1/2"H (178 mm x 127 mm x 63½ mm)
Weight:	Less than 2 lbs.
Cable Length:	Retracted: 2 ft. Extended: 10 ft.
Storage Temp.:	0-50°C (Recommended Temp. 10-30°C)
Operating Temp.:	0-40°C
Alarm Indicators:	Audible/Visible **Audio:** Pulsating .5-1 KHZ tone @ 70 to 90 DBA, 50% duty cycle. **Visual:** Red high-brightness LED.

Operating Temp.: 0-40°C

RFI Protected

Drawing List

B-41912	Schematic, Analog PC board
B-41913	Schematic, Controller PC board
B-41914	Schematic, Display PC board
C-41901	Final assembly
B-41524	Assembly, Controller PC board (all)
C-41529	Assembly, Analog PC board (all)
C-41533	Assembly, Display PC board (200, OM-100, 200T)
B-47455	Assembly, Display PC board (G, GT)
B-50600	Assembly, Display PC board (F, FT)

CAD ID: P4190143

Teledyne Anal cal Instruments
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PAR hs LIST

DRAWING NUMBER C-41901

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MODEL/SERIES: TED 200

DRAWING TITLE: FINAL ASSEMBLY

A= TED 200
B= OM-100
C= TED 200G (GERMAN VERSION)
D= TED 200F (FRENCH VERSION)
E= TED 200T
F=
G= TED 200GT (GERMAN VERSION)
H= TED 200FT (FRENCH VERSION)

42) ECO #96-219 3/27/96 APP. VMC

43) ECO #96-546 7/01/96 APP. A.A.

ITEM No.	QUANTITY A	B	C	D	E	F	G	H	T.A PART NUMBER	DESCRIPTION
1.	1	–	1	1	1		1	1	B-43 34	CASE (PER C-43764 & C-43765)
2.	–	1	–	–	–		–	–	B-55 14	CASE (PER C-55015 Shts. 1 & 2)
3.	–	–	–	1	–		–	1	C-50 03	KEYBOARD / P.C. BOARD
↑	–	–	1	–	–		1	–	C-46 33	" "
	1	–	–	–	1		–	–	C-41 41	" "
↓	–	1	–	–	–		–	–	C-55 16	" "
4.	–	–	–	1	–		–	1	C-65 9F	P.C. BOARD ASSEMBLY, DISPLAY
↑	–	–	1	–	–		1	–	C-65 9G	" " "
↓	1	1	–	–	1		–	–	C-65 9E	" " "
5.	1	1	1	1	1		1	1	B-41 4	" " , CONTROLLER
6.	1	1	1	1	1		1	1	H 2	HANDLE, VEMALINE PRODUCTS #SABA-8
7.	2	2	2	2	2		2	2	SS	SCREW, BINDER HEAD, 4-40 x 1-4"
8.	4	4	4	4	4		4	4	LL 4	LOCKWASHER #4 EXTERNAL TOOTH
9.	1	–	1	1	–		–	–	B-39 0	PROBE ASSEMBLY
10.	1	–	1	1	–		–	–	A-36 2	CLIP, PROBE
11.	4	4	4	4	4		4	4	----	SCREW, BINDER HEAD, 6-32 x 3/8"