Teledyne Electronic Devices

Model 60T

Oxygen Analyzer

Service Manual

P/N SMC40575B.03
07/10/91

This manual is intended to provide information to help qualified maintenance personnel service and repair the TED Model 60T oxygen analyzer. 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 analyzer 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 4.

Description of the TED 60T

The TED 60T is a small, battery-operated instrument used to check oxygen levels in areas where such information is vital. The unit 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.

Micro-Fuel Cell

The sensor is a Class T–7 Micro-Fuel Cell that 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.

The current output from the sensor is affected by the temperature of the gas, which is compensated for by the first stage of the amplifier circuit. The circuit varies the gain of the amplifier, which in turn is controlled by a temperature-sensitive resistor (thermistor) mounted in the sensor housing.

Amplifier

The signal current out of the sensor is very small and must be converted to a useable voltage. This conversion is done in the amplifier's first stage circuitry.

Display

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

Circuit Description

The 60T circuit is shown in drawing B40579.

Sensor

The T–7 sensor has two resistors and a thermistor mounted in the housing as shown in the upper left-hand corner of schematic B40579. Terminal 6 (green) is the common, terminal 7 (red) is the output signal, and terminal 5 (yellow) is the temperature compensation. In the presence of oxygen, the sensor puts out a current proportional to the partial pressure of oxygen in the atmosphere around the sensor, which is then sent to the temperature compensation circuit shown in the schematic.

The temperature compensating thermistor is placed in the negative feedback loop of U2. This amplifier converts the non-compensated cell current into a temperature-compensated voltage.

The voltage output of U2 is further amplified by U3. This amplified voltage drives the calibration potentiometer, which in turn drives the LCD display circuit.

Amplifier

The amplifier is driven in the negative direction proportionally according to the current level.

The proportionality constant is determined by the values of feedback resistors R11, R12, R15 and R16 and the thermistor in the sensor. Diodes provide protective features, and Q1 serves to short the output of the sensor when the power is turned off.

The second amplifier, U3, inverts and amplifies the signal in order to drive the display. The output of the amplifier goes to the calibration potentiometer so that the display can be properly adjusted.

Display

The LCD display is a 3½ digit DC voltmeter. The analog-to-digital display conversion is done by the digital display assembly, which digitizes and displays the output of the span controller. Span control is adjusted by resistive attenuation using R19, R20, and calibration potentiometer P2, which adjusts the voltmeter to read 100 when the sensor is immersed in 100% oxygen.

Pins 1 and 2 on the LCD are used to supply power to the display. Pins 5, 8, 9 and 10 are used for internal reference. Pin 6 goes to ground; pin 7 is voltage input. Pin 11 is normally jumpered to place the decimal on the display, but is not used here.

Power Supply

Power for the 60T is derived from a common 9-volt battery. R23 and R24 divide the battery voltage evenly, which then enters amplifier U4 through the positive input. U4 buffers the divided voltage, separates it into positive and negative voltages, and becomes the common reference of ground for the rest of the circuit.

Repair/Replacement

Battery Replacement

1. Turn the instrument off.
2. Open the battery compartment by sliding off the battery compartment cover.
3. Lift the battery out and disconnect it.
4. Connect a new 9-volt alkaline battery and place it in the compartment.
5. Slide the battery compartment cover back into place and calibrate.

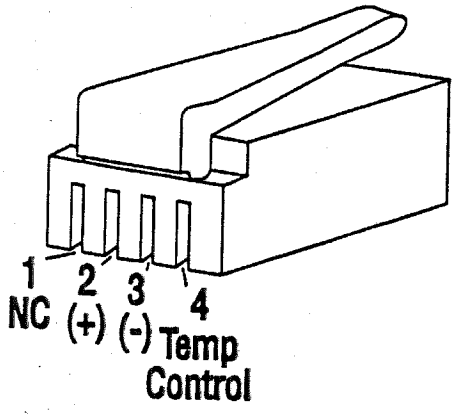
Sensor Replacement

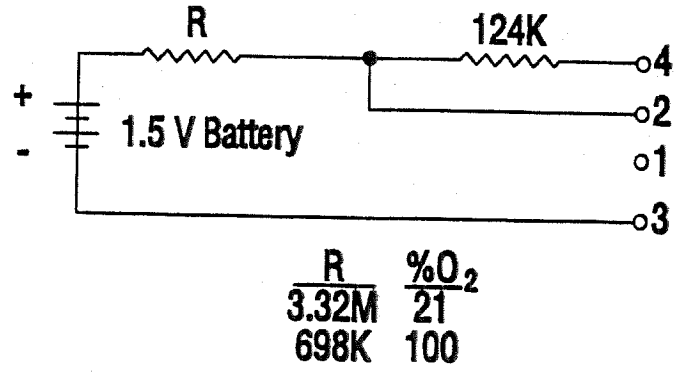
1. Turn the instrument off.
2. Unplug the coiled cable from the old sensor.
3. Remove the new sensor from its protective plastic bag.
4. Plug the coiled cable into the new sensor and calibrate.

Opening the Case

1. Turn the instrument off
2. Place it face down on a clean, non-conductive surface.
3. Remove the screws located in each corner. There are four of them.
4. Carefully lift off the back cover, being careful not to break the battery connection wires.
5. Place the back cover beside the other half. It is now ready for troubleshooting.

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





R	$\%O_2$
3.32M	21
698K	100

Sensor Simulator

Occasionally, it is necessary to simulate a sensor for testing. The sensor connector is wired as shown on the bottom of the previous page, and below it is a diagram for a simple sensor simulator.

The sensor simulator shown will only give a general indication that the TED 60T electronic circuitry is operating normally. Actual calibrations should be in air with the sensor attached.

Teledyne Electronic Devices sells a sensor simulator P/N C50613. If several Model 60T analyzers are in use, you may want one on hand for convenience, or in the event that you are unable to obtain the required parts to make your own.

Troubleshooting

A number of possible failure modes are listed, along with probable causes.

Blank LCD when turned on

a) Low battery: replace battery.
b) Replace battery wires with P/N B56 if necessary. Retest.

LCD reads 1 when turned on

a) Check LCD pin #6 with voltmeter. 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.

Instrument cannot be calibrated

a) If the display reads <13 or >33% with the sensor in air and cannot be calibrated, the sensor needs replacing.

LCD test

a) Pin #1 on the LCD pinout (pin #1 is closest to R17 & R18) should have a voltage reading of 4.5±1.0 V with reference to pin #6 (ground).
b) Pin #2 should have a voltage reading of -4.5±1.0 V.
c) The voltage reading on pin #7 should be the same as the numerals on the LCD (i.e., 12.0 mV±1% when the LCD reads 12.0).

If the pins test at these voltages, the LCD should be operating correctly.

Suggested test procedure:

1) Remove the storage cover.
2) Install 9-volt battery. Check battery contacts.
3) Press the rocker switch on the top of the unit to ON. Display should read "00"
4) Install the cell simulator.
5) With the 698K resistor in place (or the sensor immersed in 100% oxgyen), turn the calibration potentiometer on the top of the unit until the LCD reads "100".
6) Replace the 698K resistor with the 3.32M resistor (or place the sensor in room air). The LCD should read "21".

Battery check:

Remove the 9-volt battery and replace with a simulated voltage of 6.5 V. The LCD should read "BAT" in the upper left-hand corner.

Parts List for Model TED 60T

P/N	Description
A51327	T–7 Micro-Fuel Cell sensor
A53	Integrated circuit UA776
A38607	Bezel
A40581	Top panel
A40679	Case, upper half
B56	Battery clip and wire
B326	Battery, 9-volt
B40578	PC board assembly
A51823	Sensor cable
C461	47 µF capacitor
C937	Clip
C40680	Case, lower half
D62	Diode # 1N4148
D212	LCD display (with A38607 bezel)
D298	Diode
I268	Integrated circuit (op. amp.)
K39	Cap
P509	Potentiometer, 100K
R313	49.9K, 1/8W, 1% resistor
R372	90.9K, 1/8W, 1% resistor
R500	4.99M, 1/8W, 1% resistor
R502	499K, 1/8W, 1% resistor
R644	28.7K, 1/8W, 1% resistor
R514	1 meg, 1/8W, 1% resistor
R659	11.0K, 1/8W, 1% resistor
R681	30.9K, 1/8W, 1% resistor
R1562	1.13M, 1/8W, 1% resistor
R905	931K, 1/8W, 1% resistor
R921	750K, 1/8W, 1% resistor
R987	61.9K, 1/8W, 1% resistor
S208	8-pin dip socket
S777	2 position rocker switch
T648	Transistor #2N4393
B40579	Schematic drawing
C40575B	Final Assembly (shows wiring)

Modifying the TED 60J

The TED 60J with the J–1 sensor can be upgraded to a 60T, which uses a T–7 Micro-Fuel Cell. The T–7 Modification Kit (P/N A51824) contains the parts and schematics necessary to modify the 60J. Contact Teledyne Electronic Devices for further information.

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