INSTRUCTION MANUAL

FOR

TRACE OXYGEN ANALYZER

MODEL 311-D

RANGES: 0-100 PPM; 0-1000 PPM; 1% AND 100%

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MODEL 311D

1. INTRODUCTION

1.1 Description: The Teledyne Analytical Instruments (TAI) Model 311-D is a portable trace oxygen analyzer which can be operated without an external power source, and reliably calibrated without the use of cumbersome, questionable, "certified" calibration gases.

The instrument provides for trace oxygen analysis in decade steps ranging from 0-100 to 0-1000 ppm (full scale) plus a 0-1% and 0-100% calibration range that encompasses the known oxygen concentration of atmospheric air (20.9%, or 209,000 ppm).

Sample oxygen is read from an extremely accurate digital panel meter (0.1% accuracy) whose range of measurement is determined by the position of the range selector switch.

Sample gas is introduced and vented via a pair of swagelok quick-disconnect fittings that feature integral shutoff valves that automatically close when the mating male fitting is withdrawn. The fittings are an integral part of the measuring cell manifold, so that internal sample passage volume is at an absolute minimum. Sample flow control, although not critical (0.1 to 10 liters/min.), must be accomplished with accessory equipment.

1.2 Method of Analysis: The sample oxygen is measured by a unique electrochemical transducer, which functions as a fuel cell; in this instance, the fuel is oxygen. Oxygen diffusing into the cell reacts chemically to produce an electrical current that is proportional to the oxygen concentration in the gas space immediately adjacent to the transducer sensing surface. A two-stage solid state amplifier that features operational amplifiers whose power consumption per unit is less than (5) milliwatts amplifies the linear, but minute, signal produced by the transducer from trace oxygen. The dual stages of amplification provide enough gain to read on the digital panel meter and use a thermistor- controlled network to compensate for the positive temperature coefficient of the transducer.

1.3 Outstanding Features: The following unique features are incorporated into the Model 311-D:

1.3.1 Micro-Fuel Cell: The Micro-Fuel Cell is a sealed electrochemical transducer with no electrolyte to change or electrodes to clean. When the cell reaches the end of its useful life, it is merely thrown away and replaced, as one would replace a worn-out battery in a flashlight. The life of the cell is warranted by TAI (see Section 4.4) in a fashion similar to that employed by the manufacturers of automobile batteries. This procedure guarantees the customer compensation for failure of a given cell to perform as specified.

1.3.2 Reliable Calibration: The unique qualities of the Micro-Fuel Cell allow the user to calibrate the instrument with the most economical, reliable, abundant, standardization gas there is -- atmospheric air.

The special "CAL" range of the instrument is meant for calibrating the span in ambient air to 20.9% oxygen. By drawing air through the instrument (see the sample calibration procedure in Section 3.2) reliable calibration can be achieved.

After the electronics have been properly zeroed (a one-time factory operation), the instrument cannot produce an output indication in the absence of oxygen; therefore, the need for a "zero" standardization gas is obviated.

1.3.3 Integral Power Supply: The differential power and digital panel meter (DPM) requirements of the instrument amplifier are furnished by three internally-mounted 750 milliampere-hour nickel-cadmium batteries. Fully charged, these batteries will provide enough power to operate the instrument continuously for a period of ca. 500 hours. Furthermore, an overnight charge on a 2-day duty cycle should keep the original batteries usable for many years. A "LOW BATTERY" indication is shown on the digital display.

An integral charging circuit and a detachable power cord are provided so that the batteries may be recharged from any 50 or 60 cycle, 105 to 125 volt convenience outlets.

The instrument is designed to either sample or have its batteries recharged. Both operations cannot be carried out simultaneously. TAI has deliberately interlocked the circuitry in this way.

Only when the selector switch is placed in the "OFF" position will the neon lamp on the back plate of the 311D light up to indicate power to the battery charging circuit.

A current limiting resistor (53.2 ohms) is potted into the end of each battery. This assures that, under no circumstances, can more than 80 milliamperes be switched or drawn from either battery supply.

BATTERY CHECK: To determine the state of the rechargeable batteries, turn the range selector knob counter-clockwise to the battery test position and hold there; the switch is spring-loaded, and must be held. The meter should read more than 1600; otherwise, the batteries need to be recharged. Release the Range Selector Switch, and it will automatically return to the "OFF" position. When the batteries are set at a really low charge condition, the "LOW BATT" warning is displayed. Caution should be taken not to discharge the batteries any further.

1.3.4 Accuracy and Response: The Model 311D provides monitoring accuracy of ±0.2% of full scale, or ±0.2 ppm, whichever is greater, at constant temperature. A ±5% of reading accuracy is achievable throughout the operating temperature range of 30 to 125°F.

With a sample flowrate of 150 cc/min., 90% response is achieved in 10 seconds in all the positions.

1.3.5 Compact Packaging: The instrument is housed in a 6-1/8 x 9-1/2 x 5-5/8 inch aluminum case that is equipped with a carrying handle and foot pads.

Access to the instrument interior is gained by loosening (ccw) the three 1/4" slot-head fasteners on the back of the outer case. The case may then be detached from the control panel assembly.

Further disassembly may be accomplished by removing the backplate assembly from its four mounting standoffs, and laying the two separated assemblies out as illustrated on the "Analyzer Wiring Diagram". The diagram is included among the drawings at the rear of the manual.

1.3.6 Circuit Description: A Micro-Fuel Cell (Class B-2C) is used as the transducer; its output current is in proportion to the concentration of the oxygen measured. A current-to-voltage converter, A3, supplies an output voltage, whose level is set by the range switch to the span pot. A thermistor varies the gain of amplifier A2 as the temperature of the cellblock changes; this compensates for the change in output of the Micro-Fuel Cell due to changes in temperature. The output of A2 is shown on the digital panel meter (DPM). Refer to the schematic diagram.

The batteries are charged when the instrument is connected to the main power supply, and kept in the off position. The batteries are charged at 80 mAmp, set by resistor R1. In the measurement mode, amplifier A1b, which floats the ground at the center of the power supply, controls the power supplied to the amplifier and the DPM.

The synthetic ground amplifier maintains a constant ratio of 1:1 between the negative and positive power supplies. The constant ratio keeps the offset voltage of the amplifier from changing as the battery voltage varies up and down. This prevents damage to the Micro-Fuel Cell, due to oxidation caused by reverse-polarity charging. The synthetic ground is produced by connecting the non-inverting input of amplifier A1b to the junction of R7 and R8 (which is at the ground potential); the output of A1b is the synthetic ground. The resulting dual power supplies have a constant ratio of:

$$\text{Neg. supply/Pos. supply} = R7/R8 = 1.$$

WARNING: ***Caution should be exercised!*** If the battery is discharged excessively, the battery cells may be damaged, and this will shorten the life of the battery. Always check the battery charge before using the instrument.

If the battery voltage should drop to zero while the unit is operating, the FET switch Q1 shorts the Micro-Fuel Cell; this protects the cell from damage or saturating with oxygen.

2. SUPPORTING EQUIPMENT AND SERVICES

2.1 Sampling Equipment: The customer must provide a means of controlling the pressure and flowrate of the sample gas. For positive pressure applications, TAI suggests a simple throttle valve, installed in the sample line between the sample point and the analyzer. The flowrate should be limited to 0.1 to 10 liters/min. *IMPORTANT: If a pressure regulator is*

necessary or desirable, it must have a metallic diaphragm. Regulators with organic or plastic diaphragms are permeable to oxygen, and if used in the sampling system, will lead to high oxygen readings.

For atmospheric pressure sampling, connect a pump and flow control valve downstream from the analyzer and draw (rather than push) the sample through the instrument.

TAI supplies three male disconnect fittings with the instrument; one for installation of the customer's sample line, one to be used to open the vent fitting of the instrument, and one (equipped with a plastic tube) for drawing air through the unit for calibration purposes.

2.2 Power Service: A source of single-phase, 105 to 125 volt, 50 or 60 Hertz power, capable of delivering a maximum of 1/4 ampere of current will be periodically required to recharge the instrument's battery power supply. An eight-foot, UL approved, 3-wire, detachable power cord is provided with the instrument and should be stored in a safe place when not in use. As a no-cost option, the 311D can be furnished with 220-volt, 50 or 60 Hertz charging power.

3. OPERATION

3.1 Introduction: The Model 311D is delivered completely assembled and ready for instant use. The Micro-Fuel Cell is in place within the manifold, and prior to shipment the manifold was purged with an inert gas to eliminate all but traces of oxygen from the internal sampling system. The integral shutoff valves in the quick-disconnect sample fittings, if not disturbed, will maintain this inert atmosphere within the manifold indefinitely. This can be demonstrated by advancing the range selector switch to the 0-1000 ppm position.

When the range selector is advanced from the "OFF" position, power to the instrument's circuitry is established. The meter will instantly respond to the residual oxygen within the integral sample passages.

It is impossible to achieve a "perfect" seal of the internal sample system, and what the meter is indicating is the diffusion/consumption balance point of the internal sample system and the micro-fuel cell.

This "balance" point, with a properly calibrated instrument, is always within the limits of the 100 ppm range. If the reading claims off the limits of this scale, a leak in the manifold assembly is indicated.

TO EXTEND THE CELL LIFE AND MINIMIZE THE TIME REQUIRED TO MAKE THE NEXT ANALYSIS, THE INSTRUMENT SHOULD ALWAYS BE PURGED WITH THE SAMPLE OR AN INERT GAS PRIOR TO BEING TAKEN OUT OF SERVICE FOR STANDBY OR STORAGE.

3.2 Calibration: The inherently constant output of the cell during its useful life precludes a definitive calibration cycle. TAI feels that the interval between calibrations should be

dictated by the customer's application. If the instrument were being used to certify the oxygen content of a product for delivery, then a calibration prior to certification would certainly be in order. If, on the other hand, the instrument is being used to monitor or guard a sample, the evidence provided by the analyzer will determine when a calibration check is in order.

DO NOT CALIBRATE THE INSTRUMENT UNLESS THERE IS A TRACE OXYGEN GAS READILY AVAILABLE FOR PURGING IMMEDIATELY FOLLOWING THE CALIBRATION PROCEDURE. (The longer the instrument is exposed to high concentrations of oxygen, the longer it takes to get back to its working ppm range.)

3.2.1 <u>Calibration Procedure</u>: Employ the following step-by-step procedure to calibrate the instrument:

1. Stand the instrument upright on a level surface, with the range switch in the "OFF" position.

2. Advance the range switch to the "CAL" position.

3. Install the plastic-tube-equipped male disconnect fitting in <u>either</u> of the analyzer's sample ports, and a blank disconnect fitting in the other port (direction of sample flow is of no importance). A pump is recommended on the plastic tube. Pump the tube until the meter reading is stable.

<u>CAUTION</u>: **DO NOT SUCK ON THE TUBE WITH YOUR MOUTH, THERE IS A POSSIBILITY THE MICRO-FUEL CELL MAY LEAK. THE CELL CONTAINS KOH SOLUTION WHICH IS CAUSTIC AND EXTREMELY HAZARDOUS!** (See Appendix - Material Safety Data Sheet).

4. Unlock and adjust the span control until the meter reads 20.9% oxygen. **BE SURE TO RELOCK THE CONTROL AFTER THE ADJUSTMENT IS MADE.**

5. Immediately after Step 4 has been accomplished, disconnect the tubing-equipped calibration fitting, and plug in either the sample or a source of inert gas.

If the instrument is to be used for sampling after the calibration procedure has been complete, follow the decreasing oxygen reading by positioning the range switch so that the meter gives the best possible resolution of the oxygen. *DO NOT ATTEMPT TO ACTUALLY TAKE A READING UNTIL THE METER INDICATION STABILIZES.* If the sample oxygen content lies within the limits of 0-100 ppm, an overnight purge is recommended for the instrument to recover sufficiently from the effects of the 209,000 ppm oxygen concentration of air (over four decades of range differential). Recovery time is proportionally less for coarser ranges.

If, on the other hand, the instrument is not to be used immediately after calibration, and a low ppm oxygen gas is being employed as a purge, allow the manifold to be purged overnight, and then disconnect both male fittings. *ALWAYS DISCONNECT THE SOURCE FITTING FIRST, AND IMMEDIATELY THEREAFTER, THE VENT FITTING*.

3.3 Positive Pressure Sampling: When connecting the instrument to a positive pressure sample source, ALWAYS proceed as follows:

1. Before making ANY connections to the instrument, establish a sample line flow rate of 0.1 to 10 liters/min. Allow the sample to vent to atmosphere long enough to purge the line free of air.

2. Install the vent fitting first and then the sample source fitting. Be prepared to make the connections in rapid order, so that atmospheric diffusion time Through the vent fitting is held to a minimum.

When disconnecting the instrument, reverse the procedure: source fitting first, and then vent fitting.

The objective of the connect-disconnect procedure is to obviate the possibility of pressurizing the manifold. **IF A FLOWING SAMPLE WAS CONNECTED TO THE MANIFOLD WITHOUT THE VENT FITTING IN PLACE, THE PRESSURE IN THE MANIFOLD WOULD RISE AND BE EQUAL TO THE SAMPLE PRESSURE ALMOST IMMEDIATELY.** In such a situation, depending on the magnitude of the sample pressure, leaks in the manifold might result.

3.4 Atmospheric Pressure Sampling: If the sample is at atmospheric pressure (or slightly negative), a sample pump will be required downstream from the analyzer. The inlet side of the pump should also be equipped with a throttle valve, so that sample flow can be reduced to 0.1 - 10 liters/min. If pump loading is a consideration, the inlet side of the pump will have to include a bypass path that is open to the atmosphere through still another throttle valve. The sample path and bypass path may then be balanced by manipulating the two valves, so that sample flow is within the prescribed limits without loading the pump.

UNDER NO CIRCUMSTANCES SHOULD THERE BY ANY RESTRICTIONS IN THE LINE BETWEEN THE SAMPLE POINT AND THE ANALYZER -- partial-pressure-sensitive device, any oxygen readings taken under these conditions would be erroneous, and vacuums in excess of 1/3 atmosphere may damage the cell.

4. MAINTENANCE

4.1 Battery Power Supply Service. The Model 311D is for use ONLY when it is not connected to the AC power line. TAI suggests that an overnight recharge be accomplished

every two (2) days of continuous use. To recharge the batteries, place the range switch in the "OFF" position and connect the power cord to a convenience outlet. The integral charging circuit will automatically energize and regulate battery charging current when the switch is in the "OFF" position and the AC cord is plugged into the power line. ***Under no circumstances allow the instrument to remain "ON" when the "LOW BATT" warning is indicated***. Charging the batteries more than this will not damage them; allowing them to discharge completely may do so.

WARNING: **DO NOT TURN THE RANGE SWITCH EITHER TO "BATT. TEST" OR TO THE OPERATING POSITION WHILE THE UNIT IS PLUGGED INTO THE POWER LINE! DOING SO MAY CAUSE THE INTEGRATED CIRCUITS TO FAIL.**

When charging is completed, unplug the unit from the AC outlet. Turn the range switch to the "BATT. TEST" position or to the operating position. NOTE: The "BATT. TEST" position will not give a reliable indication of the battery charge immediately after a charge cycle. Allow the unit to run for awhile before testing the batteries.

If the instrument is stored with the range switch in the "OFF" position (charge cord disconnected), the period of time between charge periods should be one month. However, do not leave it longer than the one-month period.

4.2 Routine Maintenance: Beyond adhering to a battery recharge schedule, no routine maintenance is required, as there are no moving parts in the instrument. The Micro-Fuel Cell is a sealed, modular component that should be replaced when faulty.

4.3 Cell Replacement: The characteristics of the Micro-Fuel Cell are similar to those of a mercury battery, in that both provide an almost constant output through their useful life, and then fall off sharply towards zero at the end. If the sample being analyzed has a low (0-100 ppm) oxygen concentration, cell failure will probably be indicated by the inability to properly calibrate the analyzer. The user will find that very little adjustment of the 10-turn span potentiometer will be required to keep the analyzer calibrated properly during the duration of a given cell's useful life. If large, many-turn adjustments (cw) are required to calibrate the instrument, or calibration cannot be achieved within the range of the control, the cell should be immediately replaced. (Read Section 4.4 before replacing the cell.)

To offset the possibility of not having a replacement cell available when it is needed, TAI recommends that a spare cell be purchased shortly after the instrument is placed in service, and each time the cell is replaced thereafter.

The spare cell should be carefully stored in an area that is not subject to large variations in ambient temperature (75° F, nominal), and in such a way as to obviate any possibility of incurring damage***. Under no circumstances, disturb the integrity of the cell package until the cell is to be actually used.*** If the cell package is punctured and air permitted to enter, the cell will immediately start to react to the presence of oxygen.

No tools are required to replace the cell in the instrument. Simply unscrew (ccw) the plug at the bottom of the analyzer, and the cell will drop out of the manifold cavity.

Remove the new cell from its package, and carefully remove the shorting clip. Do not touch the silver-colored sensing surface of the cell -- as it is covered with a delicate Teflon membrane that can be ruptured in handling.

Place the cell on the end of the manifold plug, so that the sensing surface of the cell is in contact with the plug, and the electrical contact plate end of the cell is facing upwards. Insert the cell and plug into the manifold cavity, and screw the plug back into place. Apply as much pressure as you can with your fingers, but use no tools.

After the cell has been installed, purge the instrument with an inert gas (or the sample), and then proceed as directed in Section 3.2.1.

4.4 Cell Warranty. The Class B-2C cell employed in the Model 311D is warranted for 80,000 percent-hours or six (6) months of service (whichever occurs first).

With regard to spare cells, service time starts when the cell is removed from its shipping package. The customer should stock only one spare cell per instrument at a time. Do not attempt to stockpile spare cells.

The Model 311D should not be used in applications where CO_2 is a major component in the sample. Concentrations of 1,000 ppm or less will not effect the cell performance. See Appendix - "Effect of CO_2 on B-2C Cell Life."

If a cell was working satisfactorily, but ceases to function before the warranty period expires, the customer will receive credit, toward the purchase of a new cell.

Customer having warranty claims must return the cell in question to the factory for evaluation, after obtaining an RMA number. If it is determined that failure is due to faulty workmanship or material, the cell will be replaced at no cost to the customer.

WARNING: ***Evidence of damage due to tampering or mishandling will render the cell warranty null and void.***

5. TRANSDUCTION AND TEMPERATURE COMPENSATION

The Micro-Fuel Cell has an inherent positive temperature coefficient, the effects of which have been minimized through the implementation of a calibrated thermistor compensation circuit.

Internal electronic calibration is accomplished by TAI. However, should there by any doubt concerning it, the following procedure can be used to recalibrate. Refer to schematic.

1. Disconnect cell.
2. Move range switch to “CAL” position.
3. Adjust P1 such that the output of A3, pin 6, measures between 0 and +0.5 mV, ideally +-.3 mV.
4. Adjust P2 for 0 ± 1 mV at output of A2, pin 6.
5. Verify that the offset is the same on all ranges.
6. Re-connect cell.

6. LEAK TESTING

If a leak is suspected in the unit, **DO NOT ATTEMPT TO TIGHTEN THE DISCONNECT FITTINGS. THE FITTINGS ARE POTTED IN EPOXY AND TIGHTENING THEM WILL BREAK THE SEAL!** To check for leaks, TAI recommends one of the following procedures:

Procedure 1:

1. Purge the instrument down as low as possible.
2. Place the vent line in water and disconnect the sample.
3. Next, disconnect the vent line and place the range switch on the X100 range.
4. The unit should stay on the X100 range if there are no leaks.

Procedure 2:

1. Purge the instrument with Nitrogen at the sample port.
2. Note the reading once it has stabilized (at least 24 hours on the 0-10 ppm range) and increase the flow rate.
3. If the reading goes down, the unit, or the tubing to the unit, has a leak.

SPECIFICATION DATA

TAI SALES ORDER NUMBER

INSTRUMENT MODEL NUMBER 311D

INSTRUMENT SERIAL NUMBER

MICRO-FUEL CELL CLASS B-2C

ACCURACY: ±0.2% OF SCALE, OR ±1 PPM, WHICHEVER IS GREATER, AT A CONSTANT TEMPERATURE; ±5% OF READING, OR ±1 PPM, WHICHEVER IS GREATER, OVER THE OPERATING TEMPERATURE RANGE.

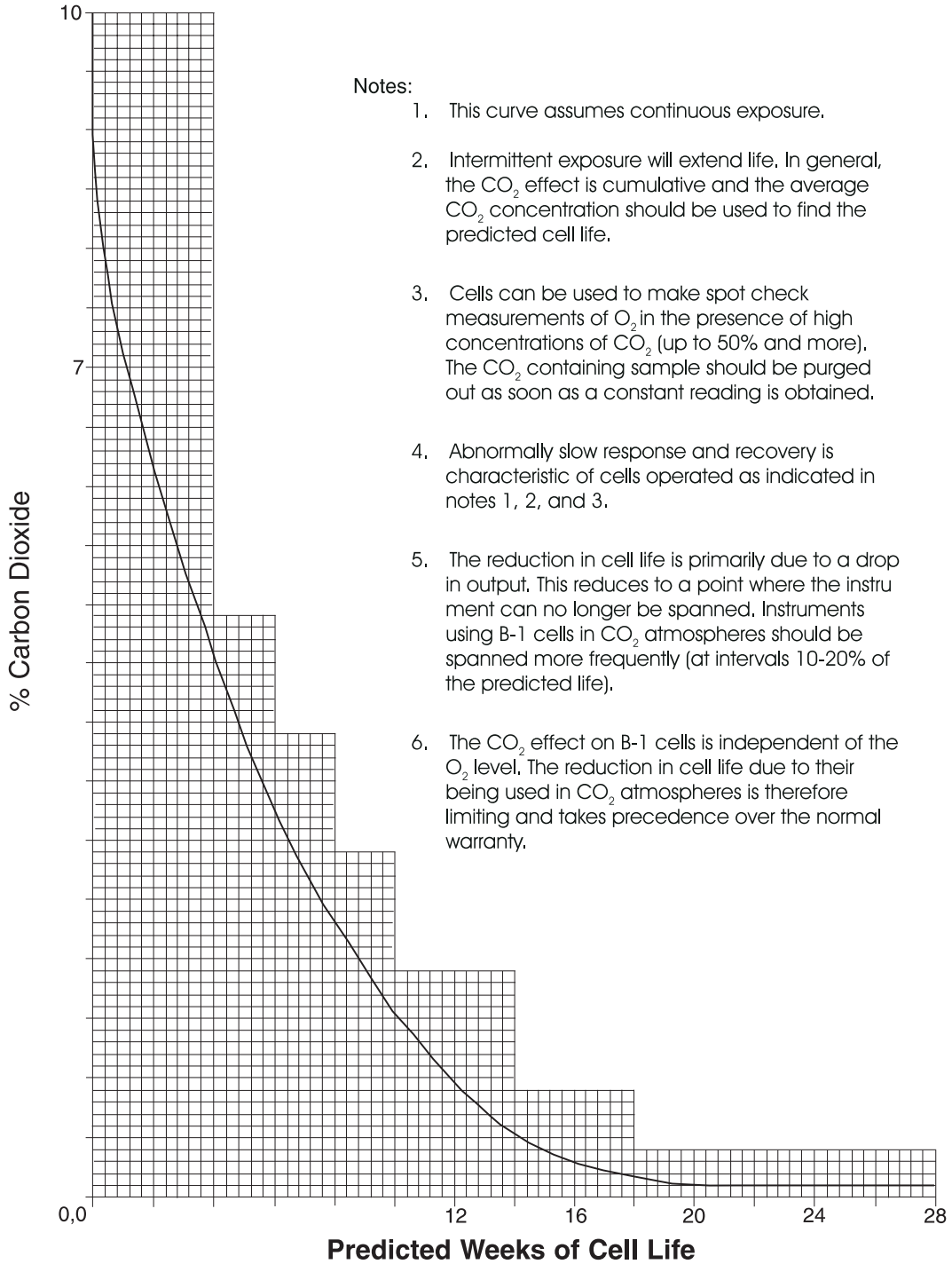
OPERATING TEMPERATURE RANGE: 30° TO 125°F.

RESPONSE AND RECOVERY: AT THE SPECIFIED FLOWRATE (0.25 SCFH), THE SENSOR OUTPUT SHOULD BE, IN TEN SECONDS, WITHIN ±10% OF AN INTRODUCED GAS HAVING A CONCENTRATION OF 100 PPM OR MORE; FOR A CONCENTRATION OF LESS THAN 100 PPM, THE SENSOR OUTPUT SHOULD BE WITHIN ±10% IN SIXTY SECONDS (PROVIDED THAT THE SENSOR IS NOT ALREADY SUPERSATURATED WITH A VERY HIGHLY-CONCENTRATED GAS, AND THE INTRODUCED GAS IS NOT VERY LOW IN CONCENTRATION.

RANGES OF ANALYSIS:	0-100	PPM OXYGEN
	0-1000	PPM OXYGEN
	0-1	% OXYGEN
	0-100	% OXYGEN (CAL.)

RECOMMENDED SPAN GAS: ATMOSPHERIC AIR.

EFFECT OF CO2 ON B-2C CELL LIFE



Notes:

1. This curve assumes continuous exposure.
2. Intermittent exposure will extend life. In general, the CO_2 effect is cumulative and the average CO_2 concentration should be used to find the predicted cell life.
3. Cells can be used to make spot check measurements of O_2 in the presence of high concentrations of CO_2 (up to 50% and more). The CO_2 containing sample should be purged out as soon as a constant reading is obtained.
4. Abnormally slow response and recovery is characteristic of cells operated as indicated in notes 1, 2, and 3.
5. The reduction in cell life is primarily due to a drop in output. This reduces to a point where the instru ment can no longer be spanned. Instruments using B-1 cells in CO_2 atmospheres should be spanned more frequently (at intervals 10-20% of the predicted life).
6. The CO_2 effect on B-1 cells is independent of the O_2 level. The reduction in cell life due to their being used in CO_2 atmospheres is therefore limiting and takes precedence over the normal warranty.

RECOMMENDED SPARE PARTS LIST

MODEL 311D

QTY.	P/N	DESCRIPTION
5	F-39	MICRO FUSE, 0.25 AMP., FAST-BLOW (FOR 210-240 VAC)
5	F-51	MICRO FUSE, 0.50 AMP., FAST-BLOW (FOR 100-125 VAC)
1	C-6689-A2C	MICRO-FUEL CELL, CLASS A2C (FOR GAS SAMPLES WITH CO2)
1	C-6689-B2C	MICRO-FUEL CELL, CLASS B-2C (STANDARD)
3	B-27296	BATTERY ASSEMBLY
1	B-30717	LCD METER ASSEMBLY
1	L-79	LAMP, NEON ASSEMBLY

A MINIMUM CHARGE IS APPLICABLE TO SPARE PARTS ORDERS.

IMPORTANT: Orders for replacement parts should include the part number (if available) model number, serial number, sales order number, and range/background of the analyzer for which the parts are intended.

SEND ORDERS TO:

TELEDYNE ANALYTICAL INSTRUMENTS
16830 CHESTNUT STREET
CITY OF INDUSTRY, CALIF. 91749

TELEPHONE: (888) 789-8168
(626) 934-1500
(626) 961-9221

FAX: (626) 961-2538
(626) 934-1651

TEC. SUPPORT: (626) 934-1673
WEB: www.teledyne-ai.com

DRAWING LIST

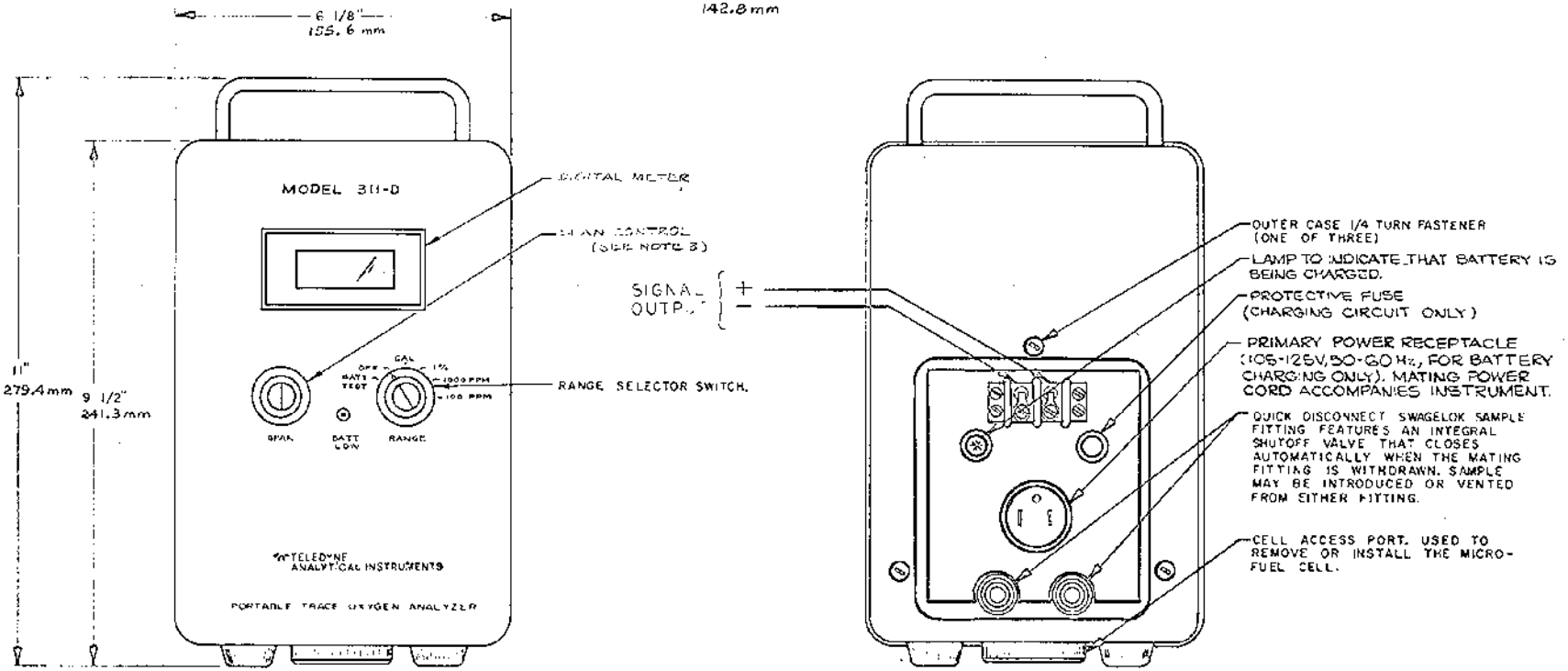
MODEL 311D

B-26473	PICTORAL DIAGRAM
C-28339	SCHEMATIC
C-26606	WIRING DIAGRAM

NOTE: **The MSDS on this material is available upon request through the Teledyne Environmental Health and Safety Coordinator. Contact at (626) 934-1592.**

ISSUE NO.	APP.
REV'D NOTES 4.) 8-8-83	11C

NOTE INSTRUMENT IS 5-5/8" DEEP. 142.8 mm



IMPORTANT OPERATIONAL NOTES

1. ALWAYS CONNECT THE VENT FITTING FIRST, AND THEN THE SAMPLE SOURCE FITTING. WHEN DISCONNECTING, ALWAYS DISCONNECT SAMPLE SOURCE FITTING FIRST, AND THEN THE VENT FITTING. PRESSURIZING THE CELL MAY DAMAGE IT AND VOID THE WARRANTY.
2. SAMPLE FLOWRATE SHOULD BE 0.1 TO 10 LITERS/MIN. IF REQUIRED, THE SAMPLE PRESSURE CAN BE REDUCED BY USING EITHER A REGULATOR OF THROTTLE VALVE.
3. TO CALIBRATE THE INSTRUMENT WITH AN AIR SAMPLE, PLACE THE RANGE SWITCH ON THE CAL. POSITION, INSTALL AN OPEN FITTING IN ONE SAMPLE PORT, AND A PLASTIC TUBE EQUIPPED FITTING IN THE OTHER PORT. GENTLY DRAW AIR INTO THE INSTRUMENT BY SUCKING ON THE PLASTIC TUBE. NOTE THE DIGITAL READING. WHEN IT STABILIZES, UNLOCK THE SPAN CONTROL AND ADJUST IT UNTIL THE READOUT IS IN COINCIDENCE WITH THE AIR SAMPLE (AIR OR CYLINDER O_2), AND RELOCK THE SPAN CONTROL. REINTRODUCE SAMPLE GAS (OR A LOW PPM OXYGEN GAS) IMMEDIATELY AFTER CALIBRATION.

TOLERANCE UNLESS OTHERWISE SPECIFIED	FRACT. ± 1/64	DEC. ± .003	ANGULAR ± 1/2°
TELEDYNE ANALYTICAL INSTRUMENTS A DIVISION OF TELEDYNE INC.		SCALE 1/2	6-8-81
		MAT'L:	
PORTABLE TRACE OXYGEN ANALYZER MODEL 311-D PICTORIAL DIAGRAM		FINISH:	
		DR H.U.	ENGR APP
		DWG No. B-26473	

PASADENA BLUEPRINT CO. PRINTED ON 1000H-8 CLEARPRINT

S.O. 125155-1

NOTES: UNLESS OTHERWISE SPECIFIED.

(1) DPM & P.C. BOARD TURN 90° FOR CLARITY.

(2) USE HEAT SHRINK SLEEVING ON ALL 10 CONNECTOR TERMINALS

REVISIONS				
REV	DESCRIPTION	DATE	APP.	REV. BY
13	INC. ECO 09-0583	7/15/05	AA	MN
14	INC. ECO 02-0069	07/19/05	AA	MN

NOTE: WIRING TO BE 22 GA. STRANDED WIRE TEFLON INSULATED, UNLESS OTHERWISE NOTED.

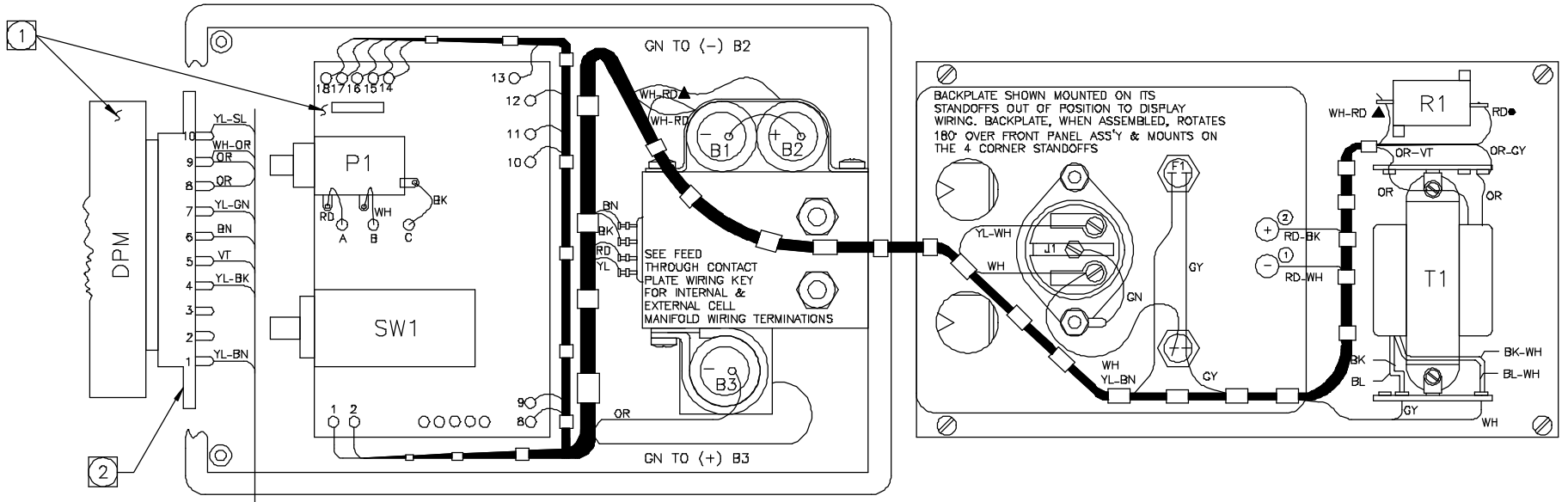
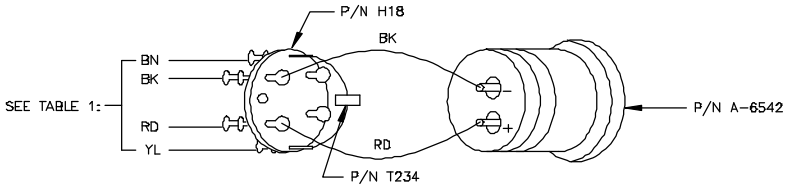


TABLE 1

P.C. BOARD TIE POINTS & WIRE COLORS:

T.P.'S	WIRE COLOR	
1	YL−BN	
2	YL−WH	
3		
4		
5		
6		
7		
8	BK	TO CELL FEED THROUGH CONTACTS
9	RD	
10	YL	
11	BN	
12	RD−BK	
13	RD−WH	
14	WH−RD	
15	RD •	
16	OR−GY	
17	OR−VT	
18	OR	



CELL FEED THROUGH−CONTACT PLATE WIRING KEY

ITEM	QTY	PART NO.	DESCRIPTION
BILL OF MATERIAL			

DO NOT SCALE DWG

TOLERANCE UNLESS OTHERWISE SPECIFIED: ANGULAR ±1/2° LINEAR .X = ±.1 .XX = ±.02 .XXX = ±.005

TELEDYNE INSTRUMENTS
Analytical Instruments
A Teledyne Technologies Company
City of Industry, California, 91748, USA

S/ C-28339	SIGNATURES	DATE
I/	DRFT: J.R.	7/14/91
N/	CHK:	
P/	APPR:	
O/	ENGR: JL	
F/ C-26606	C.O.	
REFERENCE	CAD ID C26606-14	

TITLE: MODEL 311D TRACE OXYGEN ANALYZER WIRING DIAGRAM

SCALE ---

SIM

SHEET 1 OF 1

MATL.

DWG NO. C- 26606

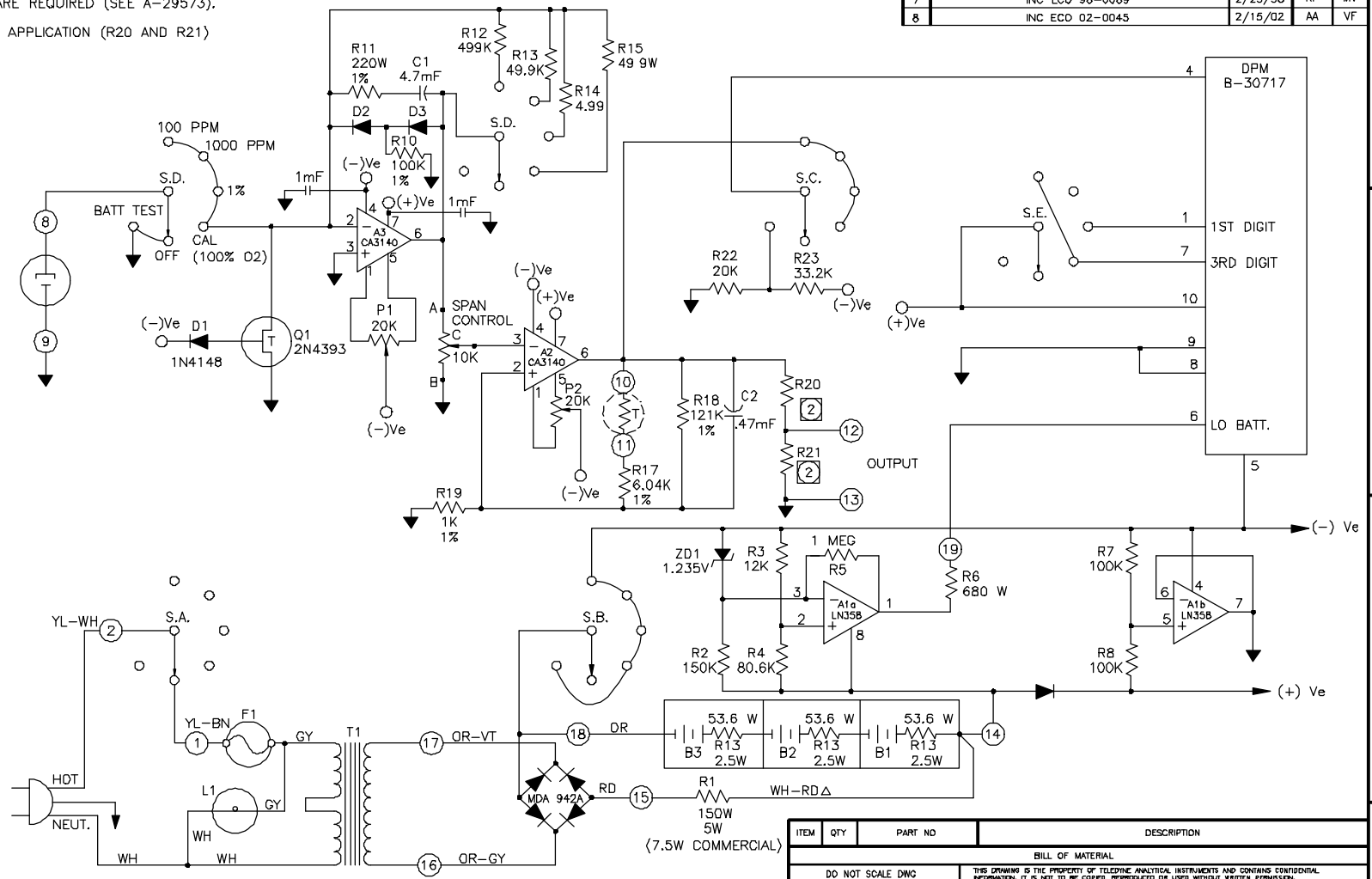
REV 14

NOTES: UNLESS OTHERWISE SPECIFIED.

1) THIS PCB CONTAINS CMOS DEVICES, ANTISTATIC HANDLING PROCEDURES ARE REQUIRED (SEE A-29573).

(2) SELECTED PER APPLICATION (R20 AND R21)

REVISIONS				
REV	DESCRIPTION	DATE	APP.	REV BY
6	INC ECO 94-598	10/21/94	JML	MV
7	INC ECO 98-0089	2/23/98	RF	MV
8	INC ECO 02-0045	2/15/02	AA	VF



ITEM	QTY	PART NO	DESCRIPTION

BILL OF MATERIAL

DO NOT SCALE DWG

TOLERANCE UNLESS OTHERWISE SPECIFIED ANGULAR ±1/2° LINEAR .X = ±.1 .XX = ±.02 .XXX = ±.010

Teledyne Analytical Instruments
A Teledyne Technologies Company
City of Industry, California, 91748, USA

	SIGNATURES	DATE
S/		
I/	DRFT: NS	3/5/82
N/	CHK:	
P/	APPR:	
O/	ENGR	
F/	C O	
REFERENCE	CAD ID C28339-8	

TITLE: SCHEMATIC TRACE O2 ANALYZER MODEL 311D

SCALE | SIM | SHEET 1 OF 1

MATL | DWG NO C-28339 | REV 8