INSTRUCTION MANUAL

FOR

COMBUSTIBLES ANALYZER

MODEL 102

SERIAL NUMBER

CUSTOMER ORDER NUMBER

SALES ORDER NUMBER

TELEDYNE ANALYTICAL INSTRUMENTS
16830 Chestnut Street
City of Industry, CA 91748
FAX (626)961-2538
EASYLINK 628-31862

A D D E N D U M

ALL COMBUSTIBLE ANALYZERS

The BUZZER toggle switch, on face on Control Panel, is a three (3) position switch. For units that do not contain a "CAUTION ALARM": This switch must be in the "full up" position to activate the AUDIO-BUZZER ALARM. The center and "full down" positions are "OFF" conditions.

TABLE OF CONTENTS

IMPORTANT NOTICE

The instrument serves as a safety monitor. However, it is the responsibility of the user to establish whether or not the total system of instrument, environment, alarm components, and any other relevant devices actually will assure safety in his particular circumstances.

The safety checklist outlined here should be treated only as a guide. It is up to the user to establish practical safety precautions. It is vital that the operator understand and test the operation of the total system.

Safety Checklist

1. Verify that the instrument is powered correctly.
2. Verify that the instrument works (all functions).
3. Verify that alarm indications give the intended results.
4. Verify that unauthorized personnel cannot tamper with the instrument or its auxiliary equipment.
5. Institute routine test/calibration procedures.
6. Identify and handle any sampling or location problems.
7. User provides any necessary warning labels; verify that the labels are on the equipment.
8. Train all operators to understand all operations and functions of the analyzer and the system.
9. Identify and handle any environmental or other influences that could affect the operation of the instrument.

MODEL 102
COMBUSTIBLE GAS ANALYZER

OPERATING INSTRUCTIONS

1. DESCRIPTION

1.1. General The combustible gas analyzer consists of two parts; first is the control unit which houses all of the calibration controls, the meter readout, the alarm relays and the power supply. The second part consists of the detector and detector mount. The sensing element is a low temperature catalytic type used in a DC constant current-excited bridge network. The bridge has two legs, one being a sensing element and the other a reference element, exposed to the atmosphere to be sampled. All operating controls and indicators are accessible from the front panel. Those that are used for normal operation are exposed directly; those that are used only during calibration or servicing are recessed behind the front panel.

1.2. Exposed Controls and Indicators

1.2.1. The power toggle switch is used to turn the AC line power on and off.

1.2.2. The prominent meter displays the concentration of the combustible gases and is graduated from 0 to 5% combustibles or from 0-100% LEL.

1.2.3. The green NORMAL light is illuminated during normal operation and indicates that the sensing element is operating properly.

1.2.4. The red ALARM light is illuminated when the gas concentration rises above the adjustable ALARM set point or in the event that the sensor fails (in which case the meter pointer will be pegged below zero).

1.2.5. The BUZZER toggle switch enables the internal buzzer to sound if the unit goes into alarm.

1.2.6. The RESET toggle switch determines the mode of the alarm relay. In the AUTO position, the alarm relays will

pull in and drop out automatically as the gas concentration goes above and below the set point. In the MANUAL position, the alarm relays will be in a latching mode such as to pull in if the gas concentration goes above the set point, the alarms can be reset to normal by switching back to the AUTO position.

1.3. Recessed Controls

1.3.1. The recessed controls are for calibration and servicing purposes and should only be used as such.

1.3.2. The SPAN control adjusts for manufacturing variations in sensitivity between elements and for various gases.

1.3.3. The ZERO control adjusts for zero meter reading with zero gas (air) exposed to the sensor cell.

1.3.4. The ALARM control allows the point at which the unit goes into alarm to be adjusted anywhere within the range of the instrument as shown by the meter reading.

1.4. Meter Trim The small potentiometer located on the main circuit board below the meter is used to trim the meter to full scale deflection at the rated output. This control is set at the factory.

1.5. Analog Output An analog output signal is provided for remote monitoring or recording. This signal may be a voltage or current signal, or both at the customer's option.

1.5.1. Analog Voltage Output This output is 0- V representing full scale excursion on the panel meter. The remote meter or recorder should have an input impedance greater than 1000 ohms.

1.5.2. Analog Current Output The following current outputs are available. The remote current meter or recorder should have an input impedance less than the indicated maximum values.

CURRENT OUTPUT	MAXIMUM LOAD IMPEDANCE
1 - 5 ma	6 K ohms
4 - 20	1.5 K ohms
10 - 50	600 ohms

2. INSTALLATION

2.1. Control Unit

2.1.1. The control unit is designed for installation in a non-hazardous, protected environment.

2.1.2. Power line connections are to be made to terminals 1, 2 and 3 as indicated on the schematic.

2.2. Detector

2.2.1. Two detector configurations are available, one for flow monitoring and one for area monitoring. Either may be located remotely from the control unit without requiring adjustments to compensate for lead wire lengths. The only restriction is that electrical resistance of each lead wire be less than 5 ohms. Detector internal connections are: red wire to sensing element, white wire to juction of sensing and reference elements, and black wire to reference element. Connection of the detector to the control unit should be: red wire to terminal 13, white wire to terminal 14, and black wire to terminal 15.

2.2.2. The flow monitor detector (P/N 12115) is provided with 1 3/16 - 18 by 3/4 threads for installation into flow adapters. It should be mounted so that the gas stream does not impinge directly on the face. Liquids should be excluded from the gas stream.

2.2.3. The area monitor detector is provided with 3/4" NPT male threads at the rear for installation into standard electrical conduit fittings. For hazardous area operation, an explosion-proof combustible gas detector assembly (P/N 12431) can be provided. The detector should be mounted vertically with it's sensing surface pointing downward.

3. OPERATION

When power is first applied, the alarm will be activated, providing a check on it. As the sensor stabilizes the alarm may be reset if the meter pointer falls below the alarm set point. To adjust the set point, use the zero control to set the meter indication to the desired alarm point, then adjust the set point control until the alarm just switches. After completion of this adjustment, return the meter indicator to zero with the zero control. If there is any possibility that the sensor was exposed to combustible gases during this set point adjustment, zero gas should be applied to the detector and the zero calibration checked.

4. CALIBRATION

A flow through adapter is provided with each area monitor. This screws into the front of the detector and may be used to flow zero and span gas by the sensor. Calibration requires two steps, adjustment of the zero balance control and adjustment of the span control. Gas flows of 1-2 SCFH must be used for this. Gas flow must enter the adapter through the side arm tube, and out the end. Flow clean air through the side arm of the adapter for two minutes, or until the meter reading stabilizes. Adjust the meter to zero using the zero control. Flow calibration gas into the side arm of the adapter for two minutes or until the meter reading stabilizes. Adjust the span control until the meter indicates the analyzed value of the span gas. Remove adapter when calibration procedure has been completed. It is recommended the detectors be calibrated regularly at intervals no greater than 90 days.

5. SPAN GAS

It is recommended that the span gas have a concentration of 2.5 - 3.0% methane or equivalent concentrations of other desired combustible gas with the balance being air. Combustibles without at least a 2 to 1 ratio of oxygen should never be allowed to flow past the sensor, or loss of sensitivity will occur, and the unit will require complete recalibration and possible sensor replacement.

Calibration of the Sensor

The area sensor should be calibrated with the compound for which it is to be used. If a mixture of gases can be present, the sensor should be calibrated on the compound which has the lowest LEL of those anticipated.

If a known mixture of the compound of interest is not available, a good approximation of the LEL response can be obtained using known mixtures of methane in air which are very stable, and can be purchased from gas suppliers at the 50% LEL value for methane (2.5%) in air.

To determine the LEL reading you would obtain for any gas listed, using methane in air, use the following formula using response factors from Table I.

$$\frac{\text{CONCENTRATION OF METHANE (\%)}}{\text{FACTOR}} \times \frac{100}{\text{LEL}} = \text{SCALE READING}$$

For example, to determine the equivalent LEL reading for ethylene using a calibrated mixture containing 1.95 percent methane in air, the calculation would be:

$$\frac{1.95}{1.26} \times \frac{100}{2.7} = 57$$

The span control on the control module would then be adjusted until the meter reads 57% LEL on the meter.

Response of Area Combustible Sensor to Various Gases

The Teledyne Analytical Instruments' remote area combustible sensor is Factory Mutual Approved for Class I, Division I, Groups B, C, and D.

Each sensor is checked at the factory to meet the calibration specifications set forth by Factory Mutual for approval. The sensor is checked at three points corresponding to 40%, 80%, and 95% LEL using mixtures of methane in air. A value 5.0 percent methane in air is used for the 100 percent LEL reading.

The response of gases other than methane are determined using methane as a standard. A sensor is exposed to a 50% LEL mixture of methane in air, and the reading calibrated. Several concentrations of the gas of interest are prepared corresponding to 40-60% LEL in air, the sensor exposed to the mixture, and readings compared to methane are taken. A response factor is then determined which relates the sensor output of a specific compound to the output obtained using methane. A list of some typical compounds is given in Table I, along with their LEL values to determine the output of the sensor to any of the gases listed, compared to the same concentration of methane, multiply the reading obtained by the factor listed. For example, if the output is calibrated with methane at 2%, the output for ethylene at 2% would be 2.0% x 1.26 = 2.52% methane equivalent.

To determine the concentration of a compound present at the sensor from the reading when calibrated with methane, divide the reading (in percent methane) by the factor. For example, if ethylene is flowing by the sensor, and a reading of 2.0% is obtained, the concentration of ethylene would be $\frac{2.0\%}{1.26} = 1.59\%$.

TABLE I

COMPOUND	LEL (1)	RESPONSE FACTOR
METHANE	5.0	1.00
HYDROGEN	4.0	0.86
CARBON MONOXIDE	12.5	0.32
ETHANE	3.0	1.20
ETHYLENE	2.7	1.26
ACETYLENE	2.5	1.39
PROPANE	2.2	1.42
PROPYLENE	2.0	1.33
BUTANE	1.9	1.54
HEXANE	1.1	1.50
CYCLOHEXANE	1.3	1.44
HEPTANE	1.05	1.59
BENZENE	1.3	1.50
PENTANE	1.5	1.45
TOLUENE	1.2	1.48
ETHYLENE OXIDE	3.6	0.76
METHYL ETHYL KETONE	1.8	0.96
METHYL ACRYLATE	2.8	0.59

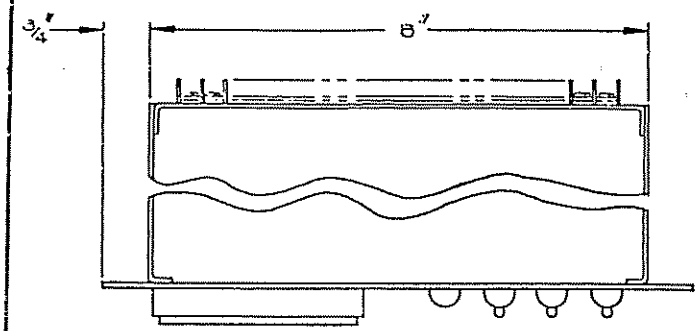
(1) Taken from Fire Hazard Properties of Flammable Liquids, Gases and Volatile Solids, National Fire Protection Association.

(2) For compounds not listed in the table, consult the factory.

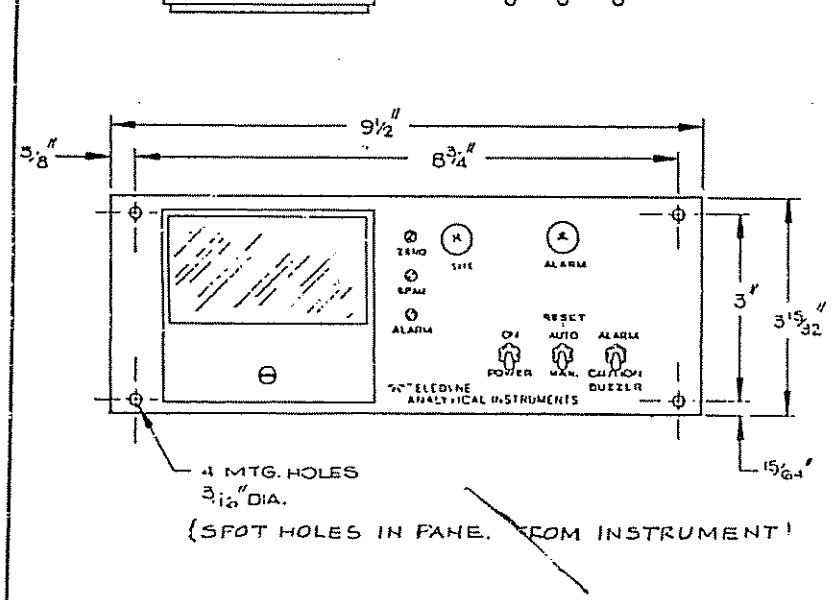
ADDENDUM TO TABLE I

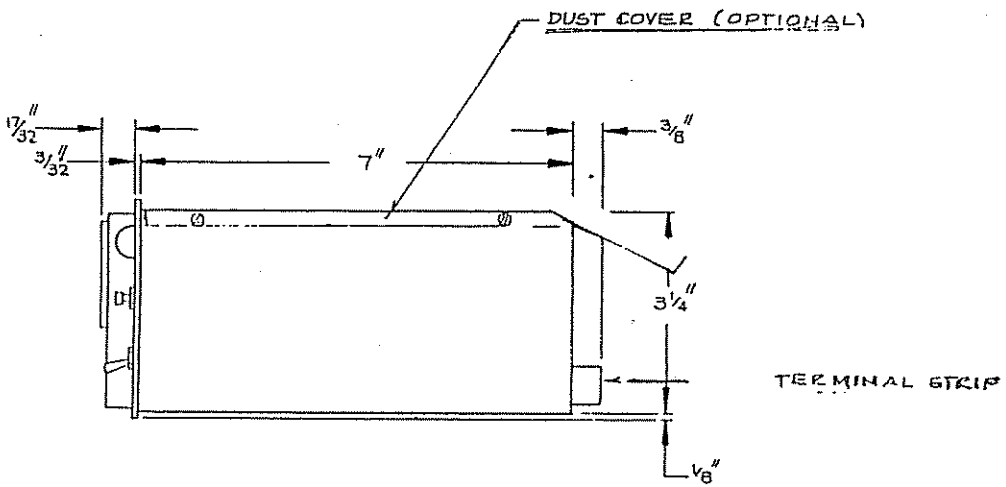
COMPOUND	LEL (1)	RESPONSE FACTOR
VINYL ACETATE	2.6	0.92
ETHANOL	3.3	0.90
BUTENE -1	1.6	1.41
1. 3 BUTADIENE	2.0	1.70
VINYL CHLORIDE	3.6	0.80
ETHYL CHLORIDE	3.8	0.85
ACETONE	2.6	0.81
METHANOL	6.7	0.66
AMMONIA	16	0.56
ISOPROPYL ALCOHOL	2.0	0.96

ISSUE NO.	APP.
1. 7-31-74	
2. 4-6-77	



NOTE: RECOMMENDED PANEL CUTOUT:
8 1/4" x 3 3/8"





TOLERANCE UNLESS OTHERWISE SPECIFIED | FRACT ± | DEC ± | ANGULAR ±

ANALYTICAL INSTRUMENTS
A TELEDYNE COMPANY
SAN GABRIEL, CALIFORNIA

SCALE 1 : 2 | DATE 7-31-74

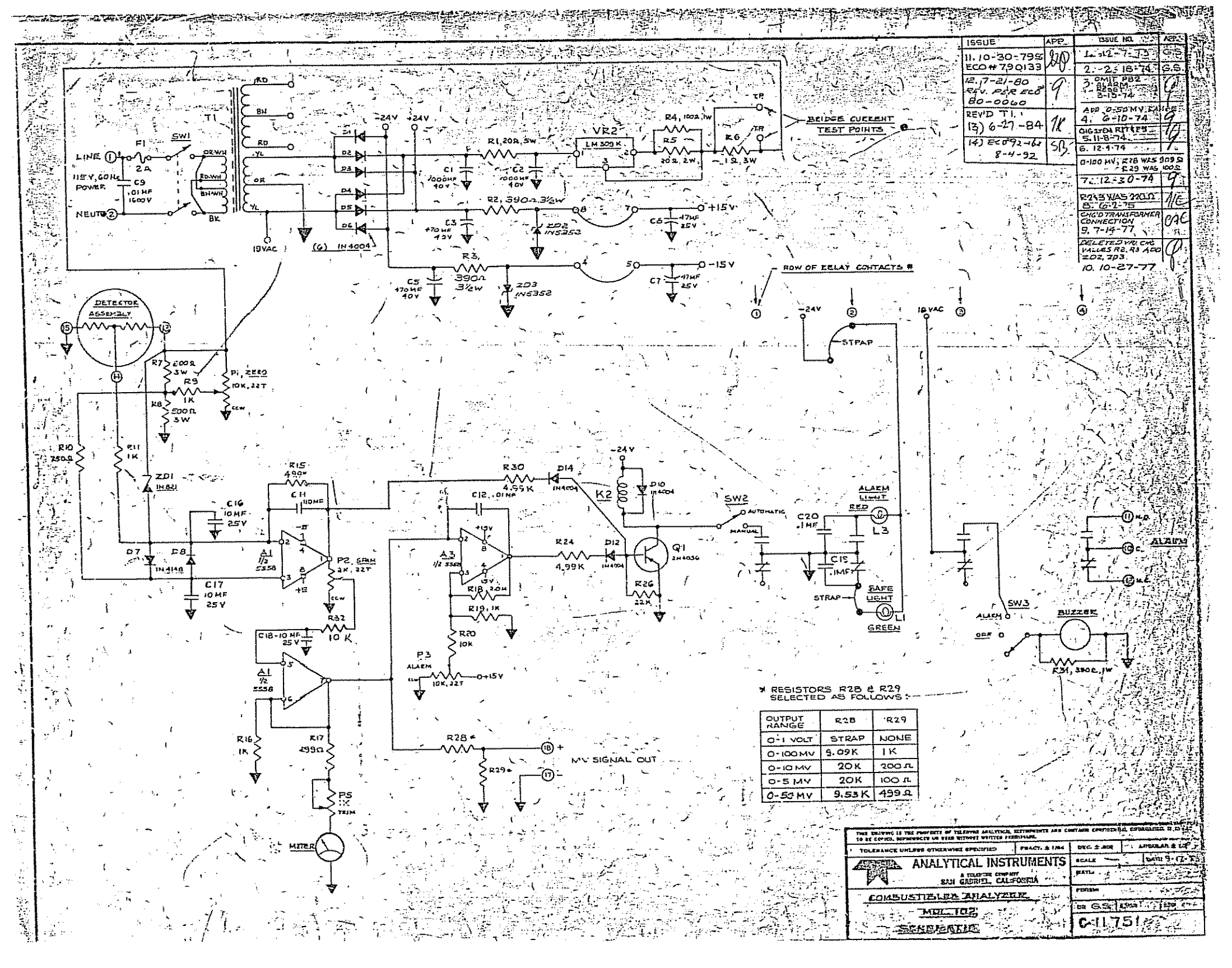
MATL ~

FINISH ~

DR G.S. | ENGR | APP

COMBUSTIBLES ANALYZER MODELS 102 & 102-I OUTLINE DIAGRAM

B-12396


ISSUE
11. 10-30-795 ECO # 7,90133
12. 7-21-80 REV. P&E ECO 80-0000
REV'D T1
13) 6-27-84
14) EC 892-62 8-4-92
ISSUE NO.
1. 5-12-7-73
2. 2-16-74
3. OMIT PB2 ALARM RESET 3-15-74
APP. 0-50 MV RANGE 4. 6-10-74
DIGITRON RATES 5. 11-8-74
6. 12-1-74
0-100 MV; R28 WAS 909 Ω R29 WAS 100 Ω
7. 12-30-74
R243 WAS 220Ω 8. 6-2-75
CHG'D TRANSFORMER CONNECTION 9. 7-14-77
DELETED VR1, CHG VALUES R2, R3 AND ZD2, ZD3. 10. 10-27-77
T1
SW1
F1
2A
LINE
NEUT
115 V, 60 Hz POWER
C9 .01 MF 1600 V
19 VAC
(6) IN4004
D1
D2
D3
D4
D5
D6
-24V
+24V
R1, 20Ω, 5W
VR2
LM 309 K
R4, 100Ω, 1W
R5 20Ω, 2W
R6 1Ω, 3W
BRIDGE CURRENT TEST POINTS
C1 1000MF 40V
C2 1000MF 40V
R2, 390Ω, 3½W
C3 470 MF 40V
ZD2 IN5352
C6 47MF 25V
+15V
R3, 390Ω 3½W
C5 470 MF 40V
ZD3 IN5352
C7 47MF 25V
-15V
ROW OF RELAY CONTACTS #
DETECTOR ASSEMBLY
R7 200Ω 3W
R9 1K
R8 200Ω 3W
P1, ZERO 10K, 22T
R10 750Ω
R11 1K
ZD1 IN821
R15 499Ω
C14 .1MF
C16 10MF 25V
C17 10MF 25V
D7 IN4148
D8
A1 ½ 5558
P2, SPAN 2K, 22T
R32 10K
C18 .1MF 25V
R16 1K
R17 499Ω
P5 1K TRIM
METER
R28 *
R29 *
MV SIGNAL OUT
R30 4.99K
D14 IN4004
D10 IN4004
K2
C12, .01MF
A3 ½ 5558
R24 4.99K
D12 IN4004
Q1 2N4036
R18 2.0M
R19, 1K
R20 10K
R26 22K
P3 ALARM 10K, 22T
SW2
AUTOMATIC
MANUAL
STPAP
18 VAC
ALARM LIGHT RED
L3
C20 .1MF
C15 .1MF
STRAP
SAFE LIGHT GREEN
L1
SW3
ALARM
OFF
BUZZER
R31, 330Ω, 1W
N.O.
N.C.
ALARM
* RESISTORS R28 & R29 SELECTED AS FOLLOWS:
OUTPUT RANGE | R28 | R29
0-1 VOLT | STRAP | NONE
0-100 MV | 9.09K | 1K
0-10 MV | 20K | 200Ω
0-5 MV | 20K | 100Ω
0-50 MV | 9.53K | 499Ω
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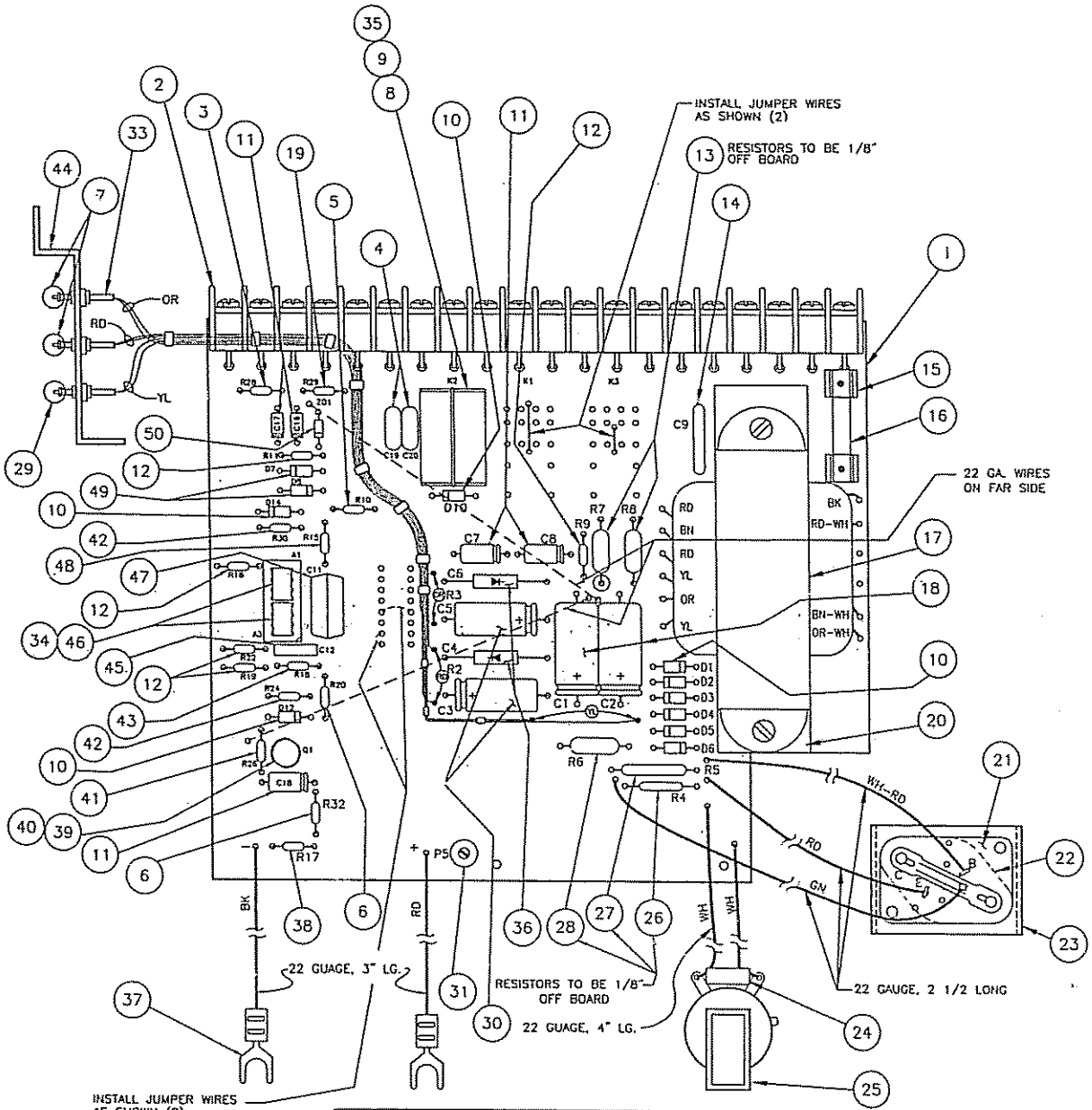
TOLERANCE UNLESS OTHERWISE SPECIFIED
FRACT. ± 1/64
DEC. ± .005
ANGULAR ± 1/2°
ANALYTICAL INSTRUMENTS
A TELEDYNE COMPANY
SAN GABRIEL, CALIFORNIA
SCALE
DATE 9-12-75
COMBUSTIBLES ANALYZER
MOL 102
SCHEMATIC
DR GS
CHK'D
APP'D
C-11751

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
12	ECO #94-579	11-16-94	JM. Laxer
13	ECO #95-272	5-3-95	



ITEM	QTY	PART NO.	DESCRIPTION
40	1	S-181	SOCKET, TRANSISTOR
39	1	T-231	TRANSISTOR #2N4036
38	1	R-441	RESISTOR, M.F. 499Ω, 1/8W
37	2		SPADE LUG
36	2	D-71	ZEENER DIODE 15V, 5W
35	1	S-206	SPRING, RELAY HOLD DOWN
34	1	S-183	SOCKET, AMPH. #821-25011-164
33	6	T-93	TERMINAL POST
32			
31	1	S-182	SOCKET, TRANSISTOR
30	2	C-680X	CAPACITOR, 470MF, 40V
29	1	R-559	RESISTOR, 20Ω, 5W
28	1	R-593	RESISTOR, 1Ω, 3 1/4W
27	1	R-562	RESISTOR, 100Ω, 1W
26	1	R-561	RESISTOR, 20Ω, 5W
25	1	B-111	BUZZER, P.B.
24	1	R-14	RESISTOR, 390Ω, 1W
23	1	A-11353	MTG. ANGLE, LM 309K
22	1	R-564	VOLT. REG. #LM309K
21	1	S-182	SOCKET, TRANSISTOR
20	1	A-11518	INSULATING PAD, X-FORMER
19	1	SELECTED	RESISTOR, MF 1/8W, SEE SCHEMATIC
18	2	C-681	CAPACITOR, 1000MF, 40V
17	1	T-317	TRANSFORMER
16	1	F10	FUSE, 3AG, 2 AMP
15	2	F-80	FUSE CLIP
14	1	C-340	CAPACITOR, .01MF, 1600V
13	2	R-563	RESISTOR, 500Ω, 3W 5%
12	5	R-310	RESISTOR, M.F., 1K, 1/8W
11	5	C-679X	CAPACITOR, 47M.F., 25V
10	9	S-89	DIODE #IN4004
9	1	S-136	SOCKET, RELAY
8	1	R-179	RELLAY, P.B. #KHP 17 D11
7	2	R-354	RESISTOR, 390Ω, 3 1/2W
6	2	R-311	RESISTOR, M.F., 10K, 1/8W
5	1	R-377	RESISTOR, M.F 750Ω 1/8W
4	2	C-193	CAPACITOR, .1 MF
3	1	SELECTED	RESISTOR, MF 1/8W, SEE SCHEMATIC
2	1	T-316	TERMINAL STRIP
1	1	C-11346	P.C. BOARD, I.D. DETAIL

BILL OF MATERIAL

ITEM	QTY	PART NO.	DESCRIPTION
50	1	Z-20	ZEENER DIODE, 6.2V, 1/4W
49	2	D-62	DIODE #IN4148
48	1	R-313	RESISTOR, 49.9K, 1/8W M.F.
47	1	C-216	CAPACITOR, 1.0MF, 100V
46	2	A3B	OP AMPLIF. #N5558 V OR MC1458 P1
45	1	C-244	CAPACITOR, .01MF, 100V
44	1	A-17656	MTG. BRACKET
43	1	R-316	RESISTOR, COMP 2.0M, 1/4W
42	2	R-411	RESISTOR, COMP 4.99K, 1/8W
41	1	R-412	RESISTOR, COMP 22K, 1/8W

C-26181 NEXT ASSY | MODEL

DO NOT SCALE DWG

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

TELEDYNE BROWN ENGINEERING
Analytical Instruments
CITY OF INDUSTRY, CALIFORNIA 91748

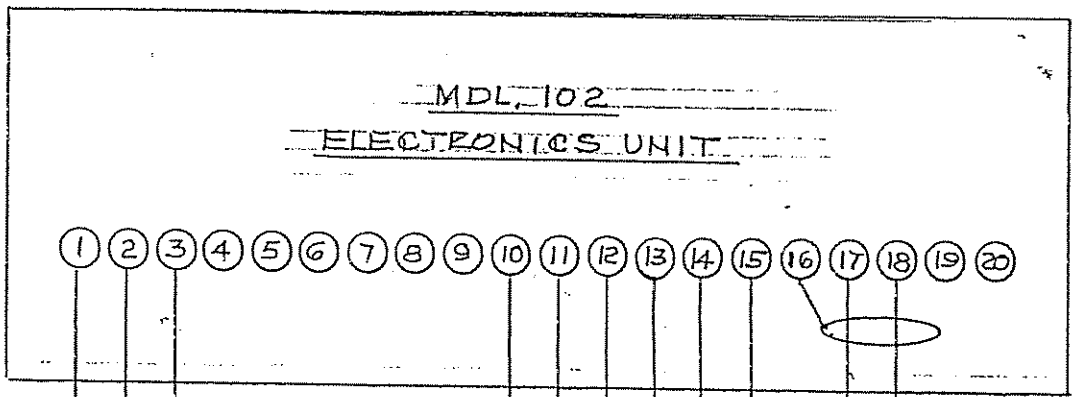
SIGNATURES		DATE
DSGN:	B.G.	10/28/94
CHK:		
ENGR:		5-1-95
APPR:		
S.O.		
CAD ID	C11572	

TITLE: COMBUSTIBLES ANALYZER MODEL 102-I P.C. BOARD ASSEMBLY

SCALE: FULL | SIM | SHEET: 1 OF 1

MATL: NOTED | DWG NO.: C-11572 | REV: 13

ISSUE NO.	APP.
1 4-4-74	
REVD POWER IN 2) 9-29-83	



TOLERANCE UNLESS OTHERWISE SPECIFIED	FRACT. ± 1/64	DEC. ± .005	ANGULAR ± 1/2°

ANALYTICAL INSTRUMENTS
A TELEDYNE COMPANY
SAN GABRIEL, CALIFORNIA

SCALE	DATE 4-4-74
MATL:	
FINISH:	
DR 9	ENGR / APP

COMBUSTIBLES ANALYZER
MDL 102
ELECTRONICS UNIT
INTERCONNECTION DIAGRAM

A-12100

RECOMMENDED SPARE PARTS LIST

FOR MODEL 102

QTY	PART NO.	DESCRIPTION
2	A-38	AMPLIFIER
1	B-12093	COMBUSTIBLE SENSOR (AREA)
1	B-12115	COMBUSTIBLE SENSOR (DILUTION SAMPLING)
2	D-71	ZENER DIODE
5	F-9	FUSE, 1A - SLO-BLO (220V)
5	F-10	FUSE, 2A - SLO-BLO (110V)
5	F-39	FUSE, 1/4A - MICROFUSE (USED WITH E/I OPTION)
5	F-51	FUSE, 1/2A - MICROFUSE (USED WITH E/I OPTION)
1	L-26	LENS COVER (GREEN - SAFE)
1*	L-27	LENS COVER (AMBER - CAUTION)
1	L-32	LAMP
1	L-39	LENS COVER (RED - DANGER)
1*	L-85	LENS COVER (BLUE - FAILURE)
1	R-179	RELAY
1	R-564	VOLTAGE REGULATOR
1	T-231	TRANSISTOR

Note: Orders for replacement parts should include the part number(if available) and the model and serial number of the instrument for which the parts are intended.

Orders should be sent to:

TELEDYNE INSTRUMENTS
ANALYTICAL INSTRUMENTS
A Teledyne Technologies Company
16830 Chestnut Street
City of Industry, CA 91748-1020
Phone (626) 961-9221 or (626) 934-1500
Fax (626) 961-2538 or (626) 934-1651
or your local representative