CSA INTERNATIONAL

Certificate of Compliance

Certificate: 190936 - 1005686 (LR 115205-1)

Project: 1005686 **Date Issued:** October 18, 1999

Issued to: **RTK Engineering Ltd.**
St. Peters Square, Harrogate,
North Yorkshire HG2 ONP
ENGLAND
Attention: Mr. Tim Mcleman

The products listed below are eligible to bear the CSA Mark shown, with adjacent indicator "C" and "US".

C US

Issued by: R. Wildish

Signature: R. Wildish

PRODUCTS

CLASS 2258 04 - PROCESS CONTROL EQUIPMENT - Intrinsically Safe Entity - For Hazardous Locations

Class I, Groups A, B, C and D:

Model LN1000/12 and LN1000/32 Annunciator; input rated 8-8.5 Vdc, 100 mA; intrinsically safe with entity parameters as listed below; installed per installation Dwg. CE4412; Temp. Code T3C @ Max Ambient 60 Deg C:

The "C" and "US" indicator adjacent to the CSA Mark signifies that the product has been evaluated to the applicable ANSI/UL and CSA Standards, for use in the U.S. and Canada. This includes products eligible to bear the NRTL indicator. NRTL, i.e. Nationally Recognized Testing Laboratory, is a designation granted by the U.S. Occupational Safety and Health Administration (OSHA) to laboratories which have been recognized to perform certification to U.S. Standards.

Term.	Entity Parameters											
	Vmax V	Imax mA	Ci nF	Li mH	Voc V	Isc mA	Ca uF A,B	Ca uF C,E	Ca uF D,F,G	La mH A,B	La mH C,E	La mH D,F,G
Sequence PCB J1: 1-2	28.5	174	4.7	.484	---	---	---	---	---	---	---	---
Sequence PCB J1: 3-4	---	---	---	---	7.2	135	14.5	43.5	116	1.9	5.7	15.2
Sequence PCB J1: 9-10-11-12	---	---	---	---	7.2	13.2	14.5	43.5	116	180	540	1440
Sequence PCB J1: (5,6, 7, 8) -12	---	---	---	---	7.2	9.5	14.5	43.5	116	320	960	2560
Alarm PCB J1: 1thru 12	---	---	---	---	7.2	32.2	14.5	43.5	116	32	96	256

Note: Model LN1000 is an open type unit Certified as a component for use only in other equipment where the suitability of the combination is to be determined by the authority having jurisdiction.

APPLICABLE STANDARDS

CSA Std C22.2 No.	142-M1987		Process Control Equipment
CAN/CSA-C22.2 No.	157-92	-	Intrinsically Safe and Non-Incendive Equipment for Use in Hazardous Locations
UL Std No.	913	-	Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II and III, Division 1, Hazardous Locations
UL Std No.	916	-	Energy Management Equipment

MARKINGS

- CSA Monogram with "NRTL/C" or "C" and "US" indicator
- Company Name
- Model No.
- Serial No.
- Electrical rating
- Hazardous Location designation
- Max ambient & Temp. Code Rating
- The symbol "Exia"
- The words "INTRINSICALLY SAFE"
- Reference to Installation Instructions
- Caution statement re. Substitution of components...

CSA INTERNATIONAL

Supplement to Certificate of Compliance

Certificate: 190936 -1005686 (LR 115205-1)

Project: 1005686

Issued to: **RTK Engineering Ltd.**
St. Peters Square, Harrogate,
North Yorkshire HG2 ONP
ENGLAND
Mr. Tim Mcleman

The products listed, including the latest revision described below, are eligible to be marked in accordance with the referenced Certificate.

Issued By: R. Wildish

Signature _____

Product Certification History

Project	Date	Description
1005686	Oct. 18/99	Original Certification - Model LN1000 Annunciator.

CSA INTERNATIONAL

PROFILE OF CERTIFICATION REPORTS

File No: 115205 0 000

Date: May 25, 1999
Replaces:

Submittor:
RTK Engineering Ltd.
St. Peters Square
Harrogate
North Yorkshire HG2 0NP
England
Attention: Mr. Tim Mcleman
Tel: 44 (0) 1423 508 253
Fax: 44 (0) 1423 531 130

Factories:		Inspection Office:	File No/Master Contract:
Contact ID	Name & Address		
282847	RTK Engineering Ltd. St. Peters Square Harrogate North Yorkshire HG2 0NP England	BSI	115205/190936

Report	Project	Contact ID	Subject
-2	-		May 25, 1999 - LED Clusters, models DA*171D, DA*172D, DA*173D and DA*174D, I.S. for hazardous locations.
1005686		-	October 18, 1999 - Models LN1000/12 and LN1000/32, Annunciator, I.S. for hazardous locations.

gl

CSA INTERNATIONAL

CERTIFICATION RECORD

The company named below has been authorized by CSA to represent the products listed in this record as "CSA Certified" and to affix the CSA Mark to these products according to the terms and conditions of the CSA Service Agreement and applicable CSA program requirements (including additional Markings).

File No: 115205 0 000

Class No: 2258 04 PROCESS CONTROL EQUIPMENT Intrinsically Safe, Entity - For Hazardous Locations

SUBMITTOR

4577224
RTK Engineering Ltd.
St. Peters Square
Harrogate
North Yorkshire, CSA Data Load HG2 0NP
United Kingdom

FACTORY

4577224
RTK Engineering Ltd.
St. Peters Square
Harrogate
North Yorkshire, CSA Data Load HG2 0NP
United Kingdom

October 18, 1999

Class I, Groups A, B, C and D:

Model LN1000/12 and LN1000/32 Annunciator; input rated 8-8.5 Vdc, 100 mA; intrinsically safe with entity parameters as listed below; installed per installation Dwg. CE4412; Temp. Code T3C @ Max Ambient 60 Deg C:

Term.	Entity Parameters											
	Vmax V	Imax mA	Ci nF	Li mH	Voc V	Isc mA	Ca uF A,B	Ca uF C,E	Ca uF D,F,G	La mH A,B	La mH C,E	La mH D,F,G
Sequence PCB J1: 1-2	28.5	174	4.7	0.48	---	--	---	---	---	---	---	---
Sequence PCB J1: 3-4	---	---	---	---	7.2	135	14.5	43.5	116	1.9	5.7	15.2
Sequence PCB J1: 9-10-11-12	---	---	---	---	7.2	13.2	14.5	43.5	116	180	540	1440

Sequence PCB J1: (5,6, 7, 8) -12	---	---	---	---	7.2	9.5	14.5	43.5	116	320	960	2560
Alarm PCB J1: 1thru 12	---	---	---	---	7.2	32.2	14.5	43.5	116	32	96	256

Note: Model LN1000 is an open type unit Certified as a component for use only in other equipment where the suitability of the combination is to be determined by the authority having jurisdiction.

gl

CSA INTERNATIONAL

CLASS DESCRIPTION RECORD

Class No.: 2258 04 PROCESS CONTROL EQUIPMENT Intrinsically Safe, Entity - For Hazardous Locations

March 17, 1993

COVERAGE:

Devices and instruments for the control and recording of industrial processes, such as detectors, recorders, analyzers, transmitters and signal processors. The process variables involved can include all of those requiring control, such as temperature, pressure, pH, voltage, flow rates, humidity, volume, size, capacitance, light levels, etc. Devices may be cord-connected or permanently-connected. Each device is evaluated as an entity subject to specified electrical parameters.

REQUIREMENTS:

CSA Standard C22.2 No 0-M	General Requirements - Canadian Electrical Code, Part II
CSA Standard C22.2 No 0.4-M	Bonding and Grounding of Electrical Equipment (Protective Grounding)
CSA Standard C22.2 No 94	Special Purpose Enclosures 2,3,4 and 5 CSA Standard C22.2 No 142-M - Process Control Equipment
CSA Standard C22.2 No 157-M	Intrinsically Safe and Non-Incendive Equipment for Use in Hazardous Locations

The certified equipment appearing in this classification is judged to comply with the applicable requirements of the NFPA National Electrical Code (NEC), for use in hazardous locations.

MARKING:

- submittor's identification;
- model designation or equivalent;
- complete electrical rating;
- maximum working pressure;
- temperature code;
- entity parameters;
- applicable hazardous locations Class, Group and sometimes Division;
- date code or equivalent;
- cautions, warnings and additional markings as may be required;
- CSA Monogram.

In addition, equipment intended for display, sale or use in the USA, is required to include other information such as warning statements, installation instructions, etc., as may be specified in the NEC.

CSA INTERNATIONAL

CERTIFICATION RECORD

The company named below has been authorized by CSA to represent the products listed in this record as "CSA Certified" and to affix the CSA Mark to these products according to the terms and conditions of the CSA Service Agreement and applicable CSA program requirements (including additional Markings).

File No: 115205 0 000

Class No: 2258 84 PROCESS CONTROL EQUIPMENT - Intrinsically Safe, Entity - For Hazardous Locations - Certified to US Standards

SUBMITTOR

4577224
RTK Engineering Ltd.
St. Peters Square
Harrogate
North Yorkshire, CSA Data Load HG2 0NP
United Kingdom

FACTORY

4577224
RTK Engineering Ltd.
St. Peters Square
Harrogate
North Yorkshire, CSA Data Load HG2 0NP
United Kingdom

October 18, 1999

Class I, Groups A, B, C and D:

Model LN1000/12 and LN1000/32 Annunciator; input rated 8-8.5 Vdc, 100 mA; intrinsically safe with entity parameters as listed below; installed per installation Dwg. CE4412; Temp. Code T3C @ Max Ambient 60 Deg C:

Term.	Entity Parameters											
	Vmax V	Imax mA	Ci nF	Li mH	Voc V	Isc mA	Ca uF A,B	Ca uF C,E	Ca uF D,F,G	La mH A,B	La mH C,E	La mH D,F,G
Sequence PCB J1: 1-2	28.5	174	4.7	0.48	---	--	---	---	---	---	---	---
Sequence PCB J1: 3-4	---	---	---	---	7.2	135	14.5	43.5	116	1.9	5.7	15.2
Sequence PCB J1: 9-10-11-12	---	--	---	---	7.2	13.2	14.5	43.5	116	180	540	1440

Sequence PCB J1: (5,6, 7, 8) -12	---	---	---	---	7.2	9.5	14.5	43.5	116	320	960	2560
Alarm PCB J1: 1thru 12	---	---	---	---	7.2	32.2	14.5	43.5	116	32	96	256

Note: Model LN1000 is an open type unit Certified as a component for use only in other equipment where the suitability of the combination is to be determined by the authority having jurisdiction.

gl

CSA INTERNATIONAL

CLASS DESCRIPTION RECORD

Class No.: 2258 84 PROCESS CONTROL EQUIPMENT - Intrinsically Safe, Entity - For Hazardous Locations - Certified to US Standards

July 12, 1993(Replaces:March 17, 1993)

COVERAGE:

Devices and instruments for the control and recording of industrial processes,such as detectors, recorders, analyzers, transmitters and signal processors.The process variables involved can include all of those requiring control,suchas temperature, pressure, pH, voltage, flow rates, humidity, volume, size,capacitance, light levels, etc. Devices may be cord-connected orpermanently-connected. Each device is evaluated as an entity subject tospecified electrical parameters.

REQUIREMENTS:

ANSI/UL Standard 508	Industrial Control Equipment
ANSI/UL Standard 913	Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations
UL Standard 1092	Process Control Equipment

MARKING:

- submittor's identification;
- model designation or equivalent;
- complete electrical rating;
- maximum working pressure:
- temperature code;
- entity parameters;
- applicable hazardous locations Class, Group and sometimes Division;
- cautions, warnings and additional markings as may be required by the applicable Standards;
- CSA Monogram and "NRTL".

CSA INTERNATIONAL

Standards Development | QMI Management Systems Registration | Certification and Testing

Descriptive and Test Report

REPORT: 190936 - 1005686

PROJECT: 1005686

Edition 1: October 18, 1999; Project 1005686 - Toronto
Issued by R. Wildish

Contents:
Certificate of Compliance - Pages 1 to 3
Supplement to Certificate of Compliance - Page 1
Description and Test Pages - Pages 1 to 9
Descriptive Document Package (CSA Engineering File Only)

178 Rexdale Boulevard, Toronto, ON, Canada M9W 1R3
Telephone: 416.747.4000 Fax: 416.747.4149 Website: www.csa-international.org

1005686\1\RW\gl

PRODUCTS

CLASS 2258 04 - PROCESS CONTROL EQUIPMENT - Intrinsically Safe Entity - For Hazardous Locations

Class I, Groups A, B, C and D:

Model LN1000/12 and LN1000/32 Annunciator; input rated 8-8.5 Vdc, 100 mA; intrinsically safe with entity parameters as listed below; installed per installation Dwg. CE4412; Temp. Code T3C @ Max Ambient 60 Deg C:

Term.	Entity Parameters											
	Vmax V	Imax mA	Ci nF	Li mH	Voc V	Isc mA	Ca uF A,B	Ca uF C,E	Ca uF D,F,G	La mH A,B	La mH C,E	La mH D,F,G
Sequence PCB J1: 1-2	28.5	174	4.7	.484	---	---	---	---	---	---	---	---
Sequence PCB J1: 3-4	---	---	---	---	7.2	135	14.5	43.5	116	1.9	5.7	15.2
Sequence PCB J1: 9-10-11-12	---	---	---	---	7.2	13.2	14.5	43.5	116	180	540	1440
Sequence PCB J1: (5,6, 7, 8) -12	---	---	---	---	7.2	9.5	14.5	43.5	116	320	960	2560
Alarm PCB J1: 1thru 12	---	---	---	---	7.2	32.2	14.5	43.5	116	32	96	256

Note: Model LN1000 is an open type unit Certified as a component for use only in other equipment where the suitability of the combination is to be determined by the authority having jurisdiction.

MARKINGS

Main markings are reverse printed on the transparent polyester membrane, which is glued and riveted to the front panel. Secondary markings are reverse printed/engraved onto a min. 0.51mm thick acrylic nameplate, which is riveted to the side of the LN1000.

ALTERATIONS

Markings as above

FACTORY TESTS

The equipment at the conclusion of manufacture and before shipment, shall withstand for one min, without breakdown, the application of the following ac potential:

500V between extra low potential live parts and exposed non-current-carrying metal parts or ground terminal, if such circuits leave or enter the enclosure.

Notes:

1. As an alternative, potentials 20 percent higher may be applied for one second.

2. Where it is more convenient to do so, the dielectric strength test may be made by applying a direct current voltage instead of an ac voltage, provided that the voltage used is 1.414 times the values specified above.

3. The test specified above shall be waived on grounded or Class 2 circuits.

Warning: The factory test specified may present a hazard of injury to personnel and/or property and should only be performed by persons knowledgeable of such hazards and under conditions designed to minimize the possibility of injury.

Descriptive Documents:

Subject	Drawing Nº	Rev.	Date
Label, LN1000 Front Panel CSA Certified version	CE4527		99/10/06
Label, LN1000 Chassis Label	CE4517		99/10/01
Control Drawing for LN1000 I.S. Annunciator	CE4412		99/09/22
LN1000 I.S. Annunciator Certification Dwg. List	CE3813		97/06/16
Alarm Card Parts List	CE3814		97/06/16
Sequence Card Parts List	CE3815		97/06/16
12 Way Backplane Circuit Diagram	CE3816		97/06/12
16 Way Backplane Circuit Diagram	CE3817		97/06/12
Alarm Card Circuit Diagram	CE3818		97/06/12
Sequence Card Circuit Diagram	CE3819		97/06/13
12 Way Backplane PCB Track and Component Layout	CE3820		97/06/12
16 Way Backplane PCB Track and Component Layout	CE3821		97/06/12
Alarm Card PCB Track Layout	CE3822		97/06/12
Sequence Card PCB Track Layout	CE3823		97/06/12
Alarm Card PCB Component Layout	CE3824		97/06/24
Sequence Card PCB Component Layout	CE3825		97/06/12
General Assembly 12 Way LN1000 I.S. Annunciator	CE3826		97/06/12
General Assembly 32 Way LN1000 I.S. Annunciator	CE3827		97/06/12

DESCRIPTION

1. General: The LN1000 Annunciator is an intrinsically safe process alarm system for installation in Class I, Div. 1 hazardous locations. It consists of four parts: the panel-mounted Chassis, the Backplane pcb, the Sequence Card pcb and the Alarm Card pcb, and can monitor up to 32 channels. The LN1000 provides a visual display of the status of remote alarm contacts and can emit an audible alarm and/or operate a remote alarm device. The LN1000/12 is a 12 channel version and the LN1000/32 is a 32 channel version.

2. Field Wiring Entity - Input Circuitry:

   2.1 Capacitance Assessment - Sequence PCB, Terminals J1: 1-2: The internal capacitance is prevented from discharging at the circuit field terminals by tridundant series blocking diodes D2, D3 and D4. The total unprotected capacitance at the circuit input field terminals is 4.7 nF. (Note: this includes the sum total of two Backplane capacitors, with a 5 % tolerance factor added) Therefore, the unprotected internal capacitance (Ci) is 4.7nF.

   2.2 Inductance Assessment - Sequence PCB, Terminals J1: 1-2: The total unprotected inductance at the 4-20 mA circuit input field terminals is 0.484 mH. (Note: this includes the sum total of inductors L1 and L2, with 10 % tolerance factor added). Therefore, the unprotected internal inductance (Li) is 0.484 mH.

3. Field Wiring Entity - Output Circuitry:

   3.1 Sequence PCB, Terminals J1: 3-4: The maximum voltage available at these terminals is limited by the dual redundant shunt zener diodes Z1 and Z2, rated 7.2 V (6.8 Vzeners with 5 % tolerance added). Output current is limited by resistor R23 (56 ohms $\pm$ 5%), to 135 mA.

   3.2 Sequence PCB, Terminals J1: 9-12: The maximum voltage available at these terminals is limited by the dual redundant shunt zener diodes Z1 and Z2, rated 7.2 V (6.8 Vzeners with 5 % tolerance added). Paralleled output current is limited by resistors R48, R49 and R50 (2.17 k-ohms) and R51 (2.2 k-ohms $\pm$ 1%); to 13.2 mA.

   3.3 Sequence PCB, Terminals J1: (5, 6, 7& 8), to 12: The maximum voltage available at these terminals is limited by the dual redundant shunt zener diodes Z1 and Z2, rated 7.2 V (6.8 Vzeners with 5 % tolerance added). Paralleled output current is limited by resistors R52, R54, R56 and R58 (4.7 k-ohms $\pm$ 1%) and R51 (2.2 k-ohms $\pm$ 1%), to 9.5 mA.

   3.4 Alarm PCB, Terminals J1: 1-2-3-4-5-6-7-8-9-10-11-12: The maximum voltage available at these terminals is limited by the dual redundant shunt zener diodes Z1 and Z2, rated 7.2 V (6.8 Vzeners with 5 % tolerance added), located on the Sequence PCB. Paralleled output current is limited by resistors R1, R2 (2.2 k-ohms $\pm$ 1%), R3, R4 (1.1 k-ohms $\pm$ 1%) and R5, R6, R7, R9, R11, R12, R13 & R15 (4.7 k-ohms $\pm$ 1%), to 32.2 mA.

4. Internal Circuits:

4.1 Capacitance Assessment - Sequence PCB: Redundant shunt zener diodes rated 7.2 V (incl. tolerance) limit the voltage available across internal capacitance. Excluding capacitors C5 and C7 (4.7 uF each) , the total capacitance clamped at this voltage is 5.7 uF, which is considered acceptable in comparison to the applicable Ignition Curve (Fig. 9) of CSA Standard C22.2 No. 157-92. Capacitor C5 (4.7 uF) is protected by series resistors R21 (100 kohms) and R22 (1 kohms). Capacitor C7 (4.7 uF) is protected by series resistors R23 (56 ohms). Under these conditions (ie. voltage clamped and current limited), both C5 and C7 are considered acceptable in comparison to the applicable Ignition Curve (Fig. 9) of CSA Standard C22.2 No. 157-92, and Fig. 18.8 of UL Standard 913.

4.2 Inductance Assessment - Sequence PCB: Other than L1 and L2, which are considered un-protected (included as Ci value), there are no other inductors on the Sequence Board.

4.3 Capacitance Assessment - Alarm PCB: Power to the Alarm Cards is limited by redundant shunt zener diodes rated 7.2 V (incl. tolerance) mounted on the Sequence pcb, and current limiting resistors R2, R3, R4 and R6. Excluding capacitors C18 and C19 (1.0 uF each) , the total capacitance clamped at this voltage is 5.88 uF, which is considered acceptable in comparison to the applicable Ignition Curve (Fig. 9) of CSA Standard C22.2 No. 157-92 and Fig. 18.8 of UL Standard 913. Capacitor C18 (1.0 uF) is protected by series resistor R67 (10 kohms). Capacitor C19 (1.0 uF) is protected by series resistor R70 (10 kohms). Under these conditions (ie. voltage clamped and current limited), both C18 and C19 are considered acceptable in comparison to the applicable Ignition Curve (Fig. 9) of CSA Standard C22.2 No. 157-92, and Fig. 18.8 of UL Standard 913. In addition, current limiting resistors mounted on the Alarm Card limit energy levels such that even when all alarm cards are considered to be connected in parallel, the maximum mass fault unprotected capacitance (94.2 uF) is considered to be limited through 6.3 ohms of resistance and clamped at 7.2 V, which is considered acceptable in comparison to the applicable Ignition Curve (Fig. 9) of CSA Standard C22.2 No. 157-92, and Fig. 18.8 of UL Standard 913.

4.4 Inductance Assessment - Alarm PCB: There are no inductors on the Alarm Card.

5. Field Connections: The terminals of the intrinsically safe input circuits (ie. J1, pins 1 and 2, on Sequence Board) are separated from all associated intrinsically safe output circuits by a distance of 2.0 mm through-air and oversurface.

6. Internal Spacings: Intrinsically safe input circuits (Vmax & Imax) and the intrinsically safe output circuits (Voc & Ioc) are separated from each other by a distance of 2.0 mm through-air and oversurface (based on peak nominal voltage of 30 V).

Spacings around critical components (resistors and zener diodes etc.) exceed the required 1.5 mm through-air and oversurface (based on peak nominal voltage of 10 V).

Spacings between Alarm cards is met via through-air spacings (2.0 mm min.) and sleeving as necessary.

7. Critical Components

7.1 Sequence PCB

Component	Designation	P/N or Type	Value @ 25C	Tol.	Power Rating
Resistors	R2, R4, R5	---	1.2 kΩ	1 %	0.5 W
Resistor	R3	---	18 kΩ	1 %	0.5 W
Resistor	R21	---	100 k Ω	1 %	0.5 W
Resistor	R22	---	1kΩ	1 %	0.5 W
Resistor	R23	---	56 Ω	5 %	2.5 W
Resistor	R48-R51	---	2.2 k Ω	1 %	>0.4 W
Resistor	R52, R54, R56, R58	---	4.7 kΩ	1 %	0.5 W
Resistor	R6	---	5.1 Ω	2 %	2.5 W
Zener Diodes	Z1, Z2	1N53xxB Series	6.8 V	---	2.1 W
Diodes	D2, D3, D4	1N4005 Rectifier	1A, 600 V	---	---

7.2 Alarm PCB

Component	Designation	Value @ 25C	Tol.	Power Rating
Resistors	R1, R2	2.2 kΩ	1 %	0.5 W
Resistor	R3,R4, R64	1.1 k Ω	1 %	0.5 W
Resistor	R5, R6, R7, R9, R11, R12, R13, R15	4.7 k Ω	1 %	0.5 W
Resistor	R17 - R24	18 kΩ	1 %	0.5 W
Resistor	R39	120 Ω	2 %	2.5 W
Resistor	R67, R70	10 kΩ	1 %	0.5 W

TESTS

Rating, Temperature and Leakage testing was waived due to the nature of the supply (20-35V dc).

Dielectric Strength: CSA Std C22.2 No 142-M1987, Cl 6.8
UL Std. 916, Sec. 49

500V ac between input terminals and chassis ground

Results: Satisfactory

Spark Ignition: CAN/CSA-C22.2 No.157-92, Cl 6.2
UL Std. 913, Sec. 37 and 38

Spark Ignition tests at the field wiring terminals were waived due to the presence of redundant series blocking diodes at the front end of the circuit.
All internal capacitance and inductance is considered acceptable because of energy limiting, in circuits containing inductance and capacitance (See Description).

Temperature Code Rating: CAN/CSA-C22.2 No.157-92, Cl 6.3
UL Std. 913, Sec. 27

The following are worst case test conditions considering possible faults and supply levels.

The barrier entity parameters (V max=28.5 V; I max=174mA) were simulated (limited to the Group D ignition curve) using a suitable 28.5 VDC supply and current limiting resistance.

Temperatures were measured by thermocouples applied directly to component surfaces; ambient by thermometer.

1. Barrier "+" connected to connector J1, Pin 1 of Sequence PCB.
   Barrier "-" connected to connector J1, Pin 3 of Sequence PCB.

   Sequence PCB

   - Transistor Q1 shorted (E to C) - component fault;
   - Capacitor C7 shorted; component fault.

   Maximum temperature on resistor R23 (56 ohm, 2.5W) 103 deg C; ambient 24 deg C. (approx. 1.7 W dissipated)

2 Barrier "+" connected to connector J1, Pin 1 of Sequence PCB.
Barrier "-" connected to connector J1, Pin 4 of Sequence PCB.

Sequence PCB

- Diode Z2 opened; component fault.

Maximum temperature on zener diode Z1 (6.8 V, 2.1W) 33 deg C; ambient 24 deg C. (approx. 1.18W dissipated)

Associated Apparatus-Inductance and Capacitance Determination: CSA Std C22.2 No 157-92, Cl 6.13

The La and Ca parameters for the output channels of the subject transmitters, were determined using the published ignition curves. Spark ignition tests verifying the combination of these parameters with the resistive parameters were waived since the resistive parameters are substantially below the ignition level with faults and factors applied.