

NOT to be distributed outside the FACTORY MUTUAL SYSTEM, except by CLIENT.

MODEL LD301 SERIES PRESSURE TRANSMITTERS
FOR
HAZARDOUS LOCATIONS

from

SMAR EQUIPAMENTOS INDUSTRIAIS LTDA.
AV. DR. ANTONIO FURLAN JR. 1028
SERTAOZINHO - SP CEP 14.160
BRAZIL

J. I. 3V1A6.AX
(3610,3611)

MARCH 13, 1992



Factory Mutual Research

1151 Boston-Providence Turnpike
P.O. Box 9102
Norwood, Massachusetts 02062



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I INTRODUCTION

1.1 Smar Equipamentos Industriais LTDA requested Approval of the apparatus listed in Section 1.2 to be in compliance with the applicable requirements of the following standards:

<u>Title</u>	<u>No.</u>	<u>Issue Date</u>
Electrical Equipment for Use in Hazardous (Classified) Locations General Requirements	Class No. 3600	March 1989
Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1 Hazardous Locations	Class No. 3610	October 1988
Note: 1.5 factor applied to voltage and current rather than energy.		
Electrical Equipment for use in Class I, Division 2, Class II, Division 2, and Class III, Divisions 1 and 2 Hazardous Locations	Class No. 3611	April 1986
Electrical and Electronic Test, Measuring, and process Control Equip.	Class No. 3810	March 1989
Enclosures for Electrical Equipment (1000 V max)	Pub. No. 250-1985 (NEMA)	May 1988

FACTORY MUTUAL RESEARCH CORPORATION

Job Identification 3V1A6.AX

1.2 The following apparatus was evaluated as intrinsically safe for Class I, II and III, Division 1, Group A, B, C, D, E, F and G hazardous indoor/outdoor (NEMA 4X) locations in accordance with entity requirements and Control Drawing No. 38A-2075, Rev. 2; nonincendive for Class I, Division 2, Group A, B, C and D hazardous indoor/outdoor (NEMA4X) locations and will appear in the Approval Guide as follows:

IS/I,II,III/1/ABCDEFG - 38A-2075/2 - Entity

NI/I/2/ABCD

Pressure Transmitter. Model LD301abc-defg-hjk-lmnp-0

Entity Parameters:

Vmax = 30 Vdc, I_{max} = 110 mA, C_i = 8 nF, L_i = 0.24 mH

- a = Type and range D1,D2,D3,D4,D5,M1,M2,M3,M4,M5,A2,A3,A4,A5,L2,L3 or L4.
- b = Diaphragm material and fill fluid 1,2,3,4,5,7 or 8.
- c = Flanges, adapters, and drain/vent valves materials C,I,H,M.
- d = Wetted O-Rings materials B, V or T.
- e = Vent/Drain position 0, U or D.
- f = Local indicator 0 or 1.
- g = Process connections 0 or 1.
- h = Electrical connection 0, A, B or Z.
- j = Zero and Span adjustments 0 and 1.
- k = Mounting bracket for 2 in. pipe mounting 0, 1 or 2.
- l = Flange material 1 or 2. (L2,L3,L4 models only).
- m = Extension length 0, 1, 2 or 3 (L2,L3,L4 models only).
- n = Diaphragm and extension materials 1,2,3 or 4(L2,L3,L4 models only).
- p = Fill fluid 1, 2 or 3 (L2,L3,L4 models only).

II DESCRIPTION

2.1 The Model LD301 Series Pressure Transmitters are two-wire transmitters which receive a pressure input and convert it to a 4 to 20 mA dc signal which is directly proportional to the applied input. They are available in differential, gage, absolute, and level measurement types. The transmitter consists of two main functional elements, a capacitive sensor and microprocessor-based electronic circuitry. The sensing element consists of a sensing diaphragm which is deflected by process pressure resulting in a variation in capacitance that is measured by the electronic circuitry. The 4 to 20 mA electrical signal is transmitted over a twisted wire pair of conductors. The transmitter is available with an optional LCD Digital Indicator.

2.2 The transmitter housing is divided into two compartments, one for field wiring and optional 4-digit LCD indicator, and the other for the electronic circuit board assemblies. Both compartments are accessed by threaded covers which screw onto the main housing. The housing material is cast aluminum with a polyester overcoat. Electrical connections are 1/2 in. NPT conduit connections, or optionally available PG 13.5 DIN and M20X1.5 metric connections. Wetted parts of the sensor are available in 316L stainless steel, Hastelloy, Monel, or Tantalum. Process flanges and adapters are available in plated carbon steel, 316 stainless steel, Hastelloy C, or Monel.

2.3 The electronic components are contained on three circuit board assemblies. The Main Board (GLL-749), the Sense Board (GLL-750), and the Indicator Board (GLL-751). A capacitance to frequency converter is contained on the Sense Board which is fully encapsulated and contains isolation circuitry that galvanically isolates the sensor from the remainder of the electronics. A Terminal Block (GLL-748) contains the input signal connection terminals. The transmitter is available in both a blind version, and a version with the 4-digit LCD indicator.

III EXAMINATION AND TESTS

Representative samples of the transmitter were examined and tested by FMRC to determine their acceptability for use in the specified hazardous locations. The examination included circuit analysis, component tests, ignition testing, temperature testing, process pressure testing, NEMA4X testing, corrosion testing, dust-exclusion testing, as well as a review of the manufacturer's documentation and the unit's physical construction. All were satisfactory and are summarized in Section III.

3.1 Intrinsic Safety Examination - Entity

Entity - Under "entity" requirements, the concept allows interconnection of intrinsically safe apparatus to associated apparatus, not specifically examined in such combination. The criteria for interconnection is that the voltage (V_{max}) and current (I_{max}) which intrinsically safe apparatus can receive and remain intrinsically safe, considering faults, must be equal to or greater than the voltage (V_{oc} or V_t) and current (I_{sc} or I_t) levels which can be delivered by the associated apparatus, considering faults and applicable factors. In addition, the maximum unprotected capacitance (C_i) and inductance (L_i) of the intrinsically safe apparatus, including interconnecting wiring, must be equal or less than the capacitance (C_a) and inductance (L_a) which can be safely connected to the associated apparatus. If these criteria are met the combination may be connected.

3.1.1 Capacitance Assessment - All internal capacitors are redundantly clamped to a maximum voltage of 8.25 Vdc by triplicated zener diodes Z1, Z2, and Z3 (MLL4737A, 7.5 V, 10%, 1W). The Main Board contains significant surface-mount solid tantalum capacitor C2, 100uF, which is protected by series metal film resistor R3, 10 ohms, 1/8 W, 5%. The Sense Board contains significant capacitor C6, 1 uF, protected by series resistor(s) R8 and/or R9, 470 ohms, 5%, 1/8 W. The above capacitors and the remaining capacitors were found to be incapable of ignition, under both normal and fault conditions, of a Group A,B mixture of hydrogen and air when compared to Figure B8 of FMRC Class Standard 3610. The transmitter field leads are protected from capacitive discharge by two series redundant RLS4148 rectifier diodes, D3 and D4. The unprotected internal capacitance, $C_i = 0.008 \text{ uF}$, results only from the capacitance of the EMI filters at the input. This capacitance, when combined with the maximum specified voltage, $V_{\text{max}} = 30.0 \text{ V}$, is acceptable.

$$V_{\text{max}} = 30.0 \text{ Vdc}$$

$$C_i = 8 \text{ nF}$$

3.1.2 Inductance Assessment - The only inductive elements are transformers, T1 and T2 located on the Sense Board, GLL-750. Both transformers are fully encapsulated within the Sense Board encapsulant.

3.1.2.1 Transformer T1 (38A-1990) provides isolated power to the sensor electronics. Both the primary and secondary windings are specified to be 338 microhenries max., and are not ignition capable under fault conditions. T1 inductance is protected from reaching the input terminals by 1 Megohm series resistor R33 and triplicated zener diodes Z1, Z2, and Z3. The contribution of T1 inductance to L_i is zero.

3.1.2.2 Transformer T2 (38A-2019) provides galvanic isolation for the sensor input signal. It was subjected to ignition testing in the most easily ignitable mixture of hydrogen and air. The winding sample with the largest measured inductance ($N1=108.5 \text{ mH}$) was tested at 27 mA (1.5 factor applied to current; $1.5 \times 18 \text{ mA} = 27 \text{ mA}$) with no ignition of the test gas. An additional test in which winding N4 was placed in series with winding N1 was tested at 27 mA and resulted in no ignition of the test gas.

3.1.2.3 The unprotected internal inductance (L_i) results from windings N1 or N4 of T2 which can appear at the transmitter terminals under fault conditions. Spark ignition testing in the most easily ignitable mixture of hydrogen and air using the change in inductance method determined the L_i to be 0.24 mH. This inductance, when combined with the maximum specified current $I_{\text{max}} = 110 \text{ mA}$, is acceptable.

$$I_{\text{max}} = 110 \text{ mA}$$

$$L_i = 0.24 \text{ mH}$$

3.1.3 Protective Component Derating - All protective components are properly derated under normal and fault conditions as applicable. Protective component testing was not required.

3.1.4 Construction - Creepage and clearance distances measured between conductive parts of the circuit affecting intrinsic safety on all circuit boards meet FMRC requirements for conformally coated circuit boards, and on PWA GLL-750 which is encapsulated. The Comparative Tracking Index (CTI) of the circuit board laminate is satisfactorily specified as 140.

3.1.5 Temperature Assessment - Temperature testing and analysis revealed that under normal conditions the transmitter contains no components which generate a surface temperature rise exceeding 10C°. Under the most unfavorable fault conditions, the hottest components are integrated circuits U1, U2 and U10 on GLL-749. These can undergo a surface temperature rise of 49C°. At a reference temperature of 40°C, the maximum surface temperature is 89°C, and no temperature marking is required.

3.1.6 Class II and Class III Evaluation - The following tests verified the suitability of the transmitter as intrinsically safe for Class II, Division 1, Groups E, F and G and Class III, Division 1 hazardous locations.

3.1.6.1 Dust Exclusion Testing - Dust exclusion testing on the enclosure was satisfactorily conducted under J.I. 2Q6A3.AX. No further testing was required for this examination.

3.1.6.2 Spark Ignition - Approval for Class II, Division 1, Groups E, F and G and Class III is also based on satisfactory test results for Class I, Division 1, Group C as described in Section 3.1.

3.2 Nonincendive Examination - Nonincendive equipment acceptability is based on the inability of the transmitter to release sufficient electrical or thermal energy under normal operating conditions to cause ignition of specific hazardous atmospheres.

3.2.1 Make/break Contacts - The only make/break contacts are reed relay contact RS1 and RS2 located on GLL-749. These switches are hermetically sealed, and are also current limited to non-incendive levels by 1 megohm resistors R40 and R41.

3.2.2 Temperature Testing - Temperature testing under normal conditions (Vmax = 45 Vdc) revealed that there are no components which generate more than a 10C° rise. Therefore no temperature marking is required on the nonincendive label.

3.3 NEMA Type 4X Enclosure Testing - A representative sample of the LD301 transmitter (LD300 enclosure with zero and span shafts) was previously subjected to hosedown, rod entry, and corrosion resistance testing under J.I. 2Q6A3.AX. Results were satisfactory. No further testing was required for this examination.

3.4 Protection From Shock, Fire, and Injury

3.4.1 Grounding - There are no accessible live parts. The enclosure is bonded to a grounding terminal with a resistance of less than 0.1 ohm, providing adequate grounding should the enclosure become live in the event of a fault. The grounding terminal is a dedicated, corrosion resistant, anti-rotate terminal which is suitably identified by the IEC417 Symbol 5017 marked on the terminal block.

3.4.2 Flame Spread Testing - Insulating materials used in the transmitter were not subjected to flammability testing because the enclosure, circuit board and other materials within it are made from flame retardant materials. All printed wiring board laminates are FR-4 epoxy resin with a 94 V-0 flammability classification.

3.4.2 Hydrostatic Test - Representative samples of the differential and gage transmitters (Maximum Rated Pressure = 3600 PSI) were subjected to a test pressure of 6800 PSI with no leakage occurring. They were then subjected to a test pressure of 10,000 PSI with no rupture that would result in flying fragments. The Flange Mounted Level Transmitter is rated at 1305 PSI. A representative sample was subjected to a test pressure of 2610 PSI with no leakage occurring. It was then subjected to a test pressure of 3915 PSI with no rupture that would result in flying fragments. In no case was there leakage of the test fluid into the electronics compartment.

3.4.3 Dielectric Strength Test - A representative sample transmitter was subjected to the application of 500 Vrms, 60 Hz, between the power supply circuit terminals connected together and the protective ground terminal (enclosure). There was no leakage or breakdown, verifying the acceptability of the insulation.

3.4.4 Field Terminal Spacing - Field terminals meet the required spacing of 3.2 mm for circuits to 50 Vrms (70 vdc).

IV MARKING

Marking meets standard requirements as illustrated by the attachment.

V REMARKS

5.1 Instructions supplied with the protective assemblies as well as the system installation instructions and the National Electric Code must be followed when installing this equipment.

5.2 Control room equipment connected to associated apparatus should not use or generate more than the maximum voltage specified for the barrier.

5.3 Tampering or replacement with nonfactory components may adversely affect the safe use of the system.

FACTORY MUTUAL RESEARCH CORPORATION

Job Identification 3V1A6.AX

5.4 For guidance on installation, see ANSI/ISA RP12.6, "Installation of Intrinsically Safe Instrument Systems in Class I Hazardous Locations."

VI FACILITIES AND PROCEDURES AUDIT

The manufacturing site in Sertaozinho, Brazil are subject to follow-up examinations on a periodic with regard to facilities and quality control procedures. Results have been satisfactory, in that the level of performance which produced the items tested is being maintained.

VII MANUFACTURER'S RESPONSIBILITIES

7.1 The documentation listed in section IX is applicable to this approval and is on file at Factory Mutual Research Corporation. No changes of any nature shall be made unless notice of the proposed change has been given and written authorization obtained from FMRC. The Approved Product - Revision Report, FMRC Form 797 shall be forwarded to Factory Mutual Research Corporation as notice of proposed changes.

7.2 On 100% of production, as a routine production line test, the transmitter shall be subjected, without electrical breakdown, to the application of a test voltage between the power supply circuit terminals connected together and accessible conductive parts. The test potential shall be 600 Vrms, 45 to 60 Hz, or 860 Vdc, applied for one second. Alternatively, the test potential shall be 500 Vrms, at a frequency between 45 to 65 Hz, or 707 Vdc applied for one minute.

VIII CONCLUSION

The apparatus described in Section 1.2 meets Factory Mutual Research Corporation requirements. Approval is effective when the Approval Agreement is signed and received by FMRC.

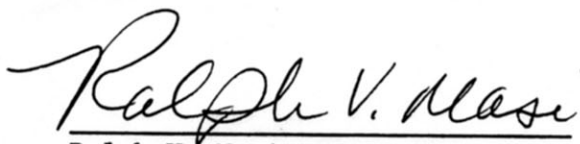
EXAMINATION AND TESTS BY: Ralph Masi, Robert Haigis

ATTACHMENTS: Drawing 38A-2075, Rev. 2.
Label Drawing 96A-131, Rev. 0.

ORIGINAL TEST DATA: Test Notebook No. 91-660.

WRITTEN BY:

REVIEWED BY:



Ralph V. Masi, Project Engineer
Instrumentation Section
Approvals Division



R.H. Lelievre, Assistant Manager
Instrumentation Section
Approvals Division

FACTORY MUTUAL RESEARCH CORPORATION

Job Identification 3V1A6.AX

IX DOCUMENTATION

The following documentation is applicable to this approval and is on file at Factory Mutual Research Corporation.

<u>Document No.</u>	<u>Revision Or Issue Date</u>	<u>Title</u>
38A-1911	07/11/90	GLL748 Component Parts List
38A-1912	07/11/90	GLL749 Component Parts List
38A-1913	07/11/90	GLL750 Component Parts List
38A-1914	07/11/90	GLL741 Component Parts List
38A-1990	16/04/91	Transformer, T1 - GLL750
38A-2019	03	Transformer, T2 - GLL750
38A-2075	2	Control Drawing
38B-1915	1	PWB Layout, GLL748
38B-1916	5	PWB Layout, GLL749
38B-1917	3	PWB Layout, GLL750
38B-1918	1	PWB Layout, GLL751
38D-1932	6	Electronic Diagram, LD-301
96A-131	0	Label, FM

**APPROVED PRODUCT/SPECIFICATION TESTED - REVISION REPORT
OR ADDRESS/CONTACT CHANGE REPORT**



SENDER: Forward with updated drawings or other appropriate change information to the attention of the **Approvals Division**. Original will be returned showing course of action taken.

Additional forms may be requested by writing to the attention of the **Factory Mutual Stock Room**.

FORWARD TO:
FACTORY MUTUAL RESEARCH
1151 Boston-Providence Turnpike
P.O. Box 9102
Norwood MA 02062

Please type below: Attention of, Company Name, Address, City, State & Zip Code.

Attn: Ricardo Leite
Smar Research Corp.
4250 Veterans Memorial HWY
Holbrook - NY
ZIP 11741

Attention: **Mr. Andrew Lozinski**

Date
February 19, 2002

FORWARD BY
Ricardo Leite

TITLE
Electronic Engineer

SIGNATURE
Ricardo Leite

MODEL(S) AFFECTED
LD301 - Pressure Transmitter

Phone: 631-737-3111

Fax: 631-737-3892

PRODUCT(S)

LD301 - PRESSURE TRANSMITTER

DOES THIS REVISION RESULT IN MODEL/TYPE NO. CHANGE TO THE CURRENT APPROVAL GUIDE LISTING? IF YES, EXPLAIN (USE SEPARATE SHEET IF REQUIRED):

YES NO

INDICATE FACTORY MUTUAL RESEARCH JOB IDENTIFICATION(S) AFFECTED
J.I. OX3A8.AE
J.I. 3V1A6. AX

HAS THE MANUFACTURING LOCATION, LISTING ADDRESS, TELEPHONE NUMBER OR CONTACT PERSON CHANGED? IF YES, EXPLAIN BELOW:

YES NO

REVISION DETAILS

	<u>DWG. NO. AFFECTED</u>	<u>REV.</u>	<u>NEW DWG. NO.</u>	<u>REV.</u>
- Main Board Model GLL1071 include the LCD assembly into bill of material, DSP1	102-B- 0513	05	102-B-0513	06 <i>-OK</i>
- The Lay-out PCB Model GLL1071, include the LCD holes fixation into PCB Drawing	102-A-0692	00	102-A-0692	01 <i>-OK</i>
- Main Board Model GLL1071, change the LCD to 3,3V type, DSP1 Include R33A Exclude R33 and C1 Change CN2 to another with lock system	102-B-0513	06	102-B-0513	07 <i>-OK</i>
- PCB Drawing (GLL1071) Apply the changes above	102-A-0692	01	102-A-0692	02 <i>-OK</i>

REASON FOR CHANGE(S)/COMMENTS:

- This LCD was not include in bill of material of approval report.
- This changes improvement electrical and production features.

BELOW FOR FACTORY MUTUAL RESEARCH USE

COMMENTS: <i>- changes do not affect safety</i> <i>- updated CDL</i>	REVISION REPORT J. I.	REVISION NOTICE NO. E01058-287-2	CLASS NO. 3610/3611/3612
	FORWARD APPROVAL/SPECIFICATION TESTED AGREEMENT		
	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		
EXAMINED BY <i>[Signature]</i>	DATE May 3, 2002		
REVIEWED BY <i>[Signature]</i>	DATE May 28, 2002		



FM Approvals
1151 Boston-Providence Turnpike
P.O. Box 9102 Norwood, MA 02062 USA
T: 781 762 4300 F: 781 762 9375 www.fmglobal.com

June 22, 2004

Mr. Graziela Castro
Smar Equipamentos Industriais Ltda.
Av: Dr. Antonio Furlan Jr. 1028
Sertaozinho, SP, Brazil CEP: 14170-480

Subject: **Re-Examination of Various Products as Nonincendive for use in Class I, Division 2, Groups A, B, C and D Hazardous (Classified) Locations**

Project ID: 3020638

Re: 4Y3A4.AX, 4B9A4.AX, 3W0A4.AX, 0D7A9.AX, 3V1A6.AX

Dear Mr. Castro,

Per your request, we have conducted the re-examination of the products identified below to the relevant requirements of FM Class 3611 Standard, issue date 1999. The products were found to be in compliance with the latest edition of FM Class 3611 Standard and therefore you may continue to mark the products as FM Approved as Nonincendive for use in Class I, Division 2, Groups A, B, C and D Hazardous (Classified) Locations.

BT302 Fieldbus Terminator
DT302 Density Transmitter
DT303 Density Transmitter
FI302 Fieldbus to Current Converter
FI303 Fieldbus to Current Converter Profibus PA
IF302 Current to Fieldbus Converter
IF303 Current to Fieldbus Converter Profibus PA
LD290 Low Cost Pressure Transmitter
LD291 Intelligent Pressure Transmitter
LD292 Smart Pressure Transmitter
LD293 Smart Pressure Transmitter
LD301 Pressure Transmitter
LD302 Level Transmitter
LD303 Pressure Transmitter Profibus PA
TT301 Intelligent Temperature Transmitter
TT302 Temperature Transmitter
TT303 Temperature Transmitter Profibus PA

The issuance of this report is considered to be the completion of this program. You will be billed for work performed to date.

Should you have any questions, or wish to pursue this activity in the future, please do not hesitate to contact the undersigned.

REPORT BY:

Brad A. Bombardier
Brad A. Bombardier
Engineer
Hazardous Locations

REPORT REVIEWED BY:

David Styrula
David Styrula
Technical Team Manager
Hazardous Locations