

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

TT301 TEMPERATURE TRANSMITTER

FOR

HAZARDOUS LOCATIONS

from

SMAR EQUIPAMENTOS INDUSTRIAIS LTDA.

AV. DR. ANTONIO FURLAN JR. 1028

SERTAOZINHO - SP CEP 14.160

BRAZIL

J. I. 3W0A4.AX
(3610,3611,3615)

SEPTEMBER 3, 1993



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
Explosionproof Electrical Equipment	Class No. 3615	March 1989
Electrical and Electronic Test, Measuring, and Process Control Equip.	Class No. 3810	March 1989
Enclosures for Electrical Equipment	ANSI/NEMA-250	1991

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1.2 The following was evaluated as explosionproof for Class I, Division 1, Groups B, C and D hazardous locations; dust-ignitionproof for Classes II and III, Division 1, Groups E, F and G hazardous locations; intrinsically safe for Class I, II and III, Division 1, Groups A, B, C, D, E, F and G hazardous locations in accordance with entity requirements and Control Drawing No. 102A-000500, issue date 22/07/93; nonincendive for Class I, Division 2, Groups A, B, C and D hazardous outdoor (NEMA 4X, NEMA 6) locations and will appear in the Approval Guide as follows:

XP/I/1/BCD; DIP/II,III/1/EFG;
IS/I,II,III/1/ABCDEFG - 102A-000500/22/07/93 - Entity
NI/I/2/ABCD

Intelligent Temperature Transmitter. Model TT301abc

Entity Parameters:

Vmax = 30 Vdc, Imax = 110 mA, Ci = 0.005 uF, Li = 8 uH

- a = Display 0 or 1.
- b = Mounting bracket 0 or 1.
- c = Adjustment 0 or 1.

1.3 This report is supplemented by FMRC reports 2Q6A3.AX which covered explosionproof, dust-ignitionproof and NEMA Type 4X testing, and OW4A9.AE which covered NEMA Type 6P, explosionproof, and dust-ignitionproof testing.

II DESCRIPTION

2.1 General - The TT301 Temperature Transmitter is a microprocessor based programmable unit which can be used with temperature sensors such as thermocouples, RTD's, millivolt or ohmic signals from position indicators. A PT100 Reference Junction sensor is encapsulated in the well. The TT301 generates a 4-20 mA output signal proportional to the temperature range on a 2-wire measurement loop. A digital communication signal (HART Protocol) can be superimposed on the same pair of wires by a hand-held terminal. The hand-held terminal is not part of this evaluation.

2.2 Enclosure - The enclosure is constructed of low copper aluminum with a polyester paint overcoat. It has two compartments, a field wiring compartment and an electronics compartment, each having a threaded cover with Buna N O-rings. It has two 1/2-14 NPT electrical conduit connections. The unit may be mounted directly to the sensor or on a 2 inch pipe using an optional bracket, or it may be fixed on a wall panel. The unit weighs 1.75 lb. (0.8 kg) without the display. The display adds 0.3 lbs. (0.13 kg), while the mounting bracket adds 1.3 lbs. (0.6 kg).

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2.3 Electronics - The electronics are mounted on six printed wiring assemblies (PWA's) all located within the electronics compartment, except GLL-804 which is mounted in the field wiring compartment. The PWA's are the GLL-800 Analog Input Board, GLL-801 Main Board, GLL-802 Indicator Board, GLL-803 Filter Board, GLL-804 Terminal Block Board, and GLL-825 Intermediate Board.

III EXAMINATION AND TESTS

Representative samples of the transmitter, components, and printed wiring boards were examined and tested by FMRC to determine their acceptability for use in the specified hazardous locations. The examination included circuit analysis, component tests, temperature testing, hydrostatic testing, as well as a review of the manufacturer's documentation and the unit's physical construction. All were satisfactory and are summarized below.

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.

The manufacturer specified the entity parameters to be as follows:

$$V_{max} = 30.0 \text{ Vdc} \qquad I_{max} = 110 \text{ mA}$$

3.1.1 Capacitance Assessment - All capacitors are redundantly clamped to a maximum voltage of 8.25 Vdc by triplicated zener diodes Z1, Z2 and Z3, MLL4737A, 7.5V, 10%, 1.0 W. There are no combinations of capacitors, under both normal and fault conditions, capable of causing spark ignition of a Group A,B mixture of hydrogen-and-air using the comparison method and the ignition curves in FMRC Standard Class 3610. All capacitors are suitably clamped by the zener diodes or suitably protected by infallible series connected current limiting resistors. The discharge of capacitive energy into the field leads is prevented by two series redundant rectifier diodes D1 and D2, ROHM Type RLR4004. The maximum internal capacitance, C_i , is 0.005 uF and results only from the capacitance of the EMI filters at the input terminals. This capacitance when combined with the maximum specified voltage, $V_{max} = 30 \text{ V}$, is acceptable.

$$V_{max} = 30 \text{ Vdc} \qquad C_i = 0.005 \text{ uF}$$

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3.1.2 Inductance Assessment - The only inductive component is Isolation Transformer TF1, P# 38A-2120, Rev. 02, located on Main Board GLL-801. The primary winding (N1) inductance is 203 mH maximum, and the secondary winding (N2) inductance is 216 mH maximum. Spark ignition testing under the most unfavorable fault conditions using a test gas mixture of hydrogen-and-air verified both the primary and secondary windings to be incapable of spark ignition. Under 2-fault conditions, the primary winding (N1) in series with resistor R1 (49.9 ohms, 1%, 1W) can appear across the TT301 field terminals. Spark ignition testing determined the maximum internal inductance (Li) to be 8 microhenries. This inductance, when combined with the maximum specified current, $I_{max} = 110$ mA, is acceptable.

$$I_{max} = 110 \text{ mA} \qquad Li = 8 \text{ uH}$$

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

3.1.4 Creepage and Clearance, CTI - Creepage and clearance distances on all circuit boards measured between conductive parts of the circuit affecting intrinsic safety meet the requirements of Table 6.1 of FMRC Standard Class 3610 in accordance with the applicable circuit voltages. The Comparative Tracking Index (CTI) of the circuit board laminate is satisfactorily specified as 140. Field terminals meet the required spacing of 3.2 mm.

3.1.5 Temperature Evaluation - Under the most unfavorable fault conditions, the hottest component is Regulator U1, MAX666ESA, 8 Lead SOIC. This component undergoes a surface temperature rise of 81C°. Referred to an ambient temperature of 40°C, its surface temperature is 121°C, and a Temperature Identification Number of T4 is required to appear on the apparatus.

Temperature Identification Number = T4

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

3.1.6.1 Dust-ignitionproof Testing - The TT301 enclosure is similar to the enclosures tested under J.I. 2Q6A3.AX and OW4A9.AE. Dust-ignitionproof testing was satisfactory. 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 Explosionproof Examination and Testing - The following tests verify the suitability of the TT301 Series Temperature Transmitters as explosionproof for Class I, Division 1, Group B, C and D hazardous (classified) locations.

3.2.1 Ignition Tests - The TT301 enclosure is similar to the enclosure tested and Approved as explosionproof for Class I, Division 1, Group B, C and D hazardous locations under J.I. 0W4A9.AE and 2Q6A3.AX. No ignition testing was required. The only additional testing required for this examination was the hydrostatic test described in Sec. 3.2.2.

3.2.2 Hydrostatic Test - A hydrostatic test was performed on a sample TT301 enclosure at a pressure of four times the maximum recorded pressure during ignition testing (4 X 135 psi = 540 psi) as recorded in J.I. 0W4A9.AE. The pressure was increased gradually to 540 psi and held for one minute. The sample was tested with a hole drilled through the partition between the compartments. Tests were run on the electronics side with blank covers on both compartments. The tests were satisfactory in that the sample was not permanently damaged or deformed at the conclusion of the test.

3.3 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.

3.3.1 Make/Break Contacts - The only arcing components are span (RS2) and zero (RS1) reed switches located on GLL-801 Main Board. These operate at nonincendive levels of 7.5V and 7.5 microamperes. Additionally, they are in hermetically sealed glass envelopes.

3.3.2 Fuses and Connectors: - There are no fuses or connectors in this apparatus.

3.3.3 Temperature Evaluation - Under normal conditions, at the maximum supply voltage of 45 Vdc and maximum output, there are no components which undergo a temperature rise greater than 40C°. No temperature marking is required on the nonincendive label, however the T4 Temperature Identification Number as determined in Sec. 3.1.5 appears on the hazardous location label and is also satisfactory for Division 2.

3.4 NEMA Type 4X and Type 6P Enclosure Testing - Water Hosedown, Corrosion Resistance, External Icing, and Submersion testing was satisfactorily completed on enclosures similar to the TT301 enclosure under J.I.'s 2Q6A3.AX and 0W4A9.AE. All results were satisfactory. No further testing was required for this examination.

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3.5 Protection From Shock, Fire, and Injury - Protection against shock, fire and injury is based upon the ability of the equipment to minimize the risk of electrical shock, injury, or fire.

3.5.1 Accessibility To Live or Moving Parts - The enclosure satisfactorily prevents the operator from contact with energized circuitry. There are no moving parts.

3.5.2 Grounding - All parts of the enclosure are 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 Ground Symbol #5017 molded directly into an insulated barrier terminal block. The enclosure also contains a pressure type ground terminal on the outside of the enclosure.

3.5.3 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 ANSI/UL-94 V-0 flammability classification. This specification meets FMRC requirements. The transmitter affords the required degree of protection against fire.

3.5.4 Dielectric Strength Testing - 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.

3.5.5 Enclosure Temperature Rise - The maximum enclosure surface temperature rise is well below the maximum allowed temperature rise of 35C° for accessible enclosure surfaces.

IV MARKING

Marking meets standard requirements as illustrated by the attachment.

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V REMARKS

5.1 Instructions supplied with the protective assemblies as well as the system installation instructions and the National Electric Code (ANSI/NFPA 70) must be followed when installing this equipment.

5.2 Control room equipment connected to associated apparatus should not use or generate more than 250 Vrms.

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

5.4 For guidance on installation, see ANSI/ISA RP12.6, "Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations."

VI FACILITIES AND PROCEDURES AUDIT

The manufacturing site in Sertaozinho, Brazil is examined on a periodic basis with regard to facilities and quality control procedures. Results are satisfactory in that the level of performance assures continued product quality as originally Approved herein.

VII MANUFACTURER'S RESPONSIBILITIES

7.1 The documentation listed in Section VIII 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.

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Job Identification 3W0A4.AX

VIII DOCUMENTATION

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

<u>Document No.</u>	<u>Revision</u>	<u>Title</u>
96B027	1	TAMPA MACHO USINADA
96B028	2	TAMPA MACHO C/VISOR USINADA
96D-124	1	CARCAQA INJETADA-USINAGEM
096D-0134	02	DIMENSIONAL DRAWING WITH INDICATOR
096D-0135	02	DIMENSIONAL DRAWING WITHOUT INDICATOR
38A-2120	2	TT301, TRANSFORMER, TF1-GLL801
38B-2111	1	TT301, LAY-OUT, GLL800
38B-2112	1	TT301, LAY-OUT, GLL801
38B-2113	5/18/92	TT301, LAY-OUT, GLL802
38B-2114	5/18/92	TT301, LAY-OUT, GLL803
38B-2115	5/18/92	TT301, LAY-OUT, GLL804
38B-2116	5/18/92	TT301, LAY-OUT, GLL825
38D-2053-06	6	ELECTRONIC DIAG., GLL800, 801, 802, 803, 804 AND 825
81A-343	0	RING OF VISOR
81A-364	1	VISOR OF GLASS.
096A0174	00	PLACA FM TT-301 (HAZ. LOCATION LABEL)
102A-000500	22/07/93	TT301 CONTROL DRAWING
LM-102-0002-02	02	ASSEMBLY EXPLOSION, PCB, GLL800
LM-102-0003-01	01	ASSEMBLY EXPLOSION, PCB, GLL801
LM-102-0004-00	00	ASSEMBLY EXPLOSION, PCB, GLL802
LM-102-0005-00	00	ASSEMBLY EXPLOSION, PCB, GLL803
LM-102-0006-00	00	ASSEMBLY EXPLOSION, PCB, GLL804
LM-102-0007-00	00	ASSEMBLY EXPLOSION, PCB, GLL825
LM-102-0008-01	01	ASSEMBLY EXPLOSION, TT301-GENERAL

FACTORY MUTUAL RESEARCH CORPORATION

Job Identification 3WOA4.AX

IX 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, M. Morrow, R. Haigis

ATTACHMENTS: Control Drawing 102A-000500, Issue Date 22/7/93
Label Drawing 096A0174, Rev. 00

ORIGINAL TEST DATA: Test Notebook No. 93-281.


WRITTEN BY:



Ralph V. Masi, Project Engineer

Instrumentation Section
Approvals Division

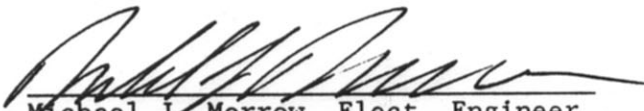
REVIEWED BY:



R.H. Lelievre, Assistant Manager

Instrumentation Section
Approvals Division

REVIEWED BY:



Michael J. Morrow, Elect. Engineer

Electrical Section
Approvals Division

**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

Phone: 631-737-3111

Fax: 631-737-3892

PRODUCT(S)

TT301 - TEMPERATURE 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

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

YES NO

Attention: Mr. Andrew Lozinski

Date
April 15, 2002

FORWARD BY
Ricardo Leite

TITLE
Electronic Engineer

SIGNATURE
Ricardo Leite

MODEL(S) AFFECTED
TT301
Temperature Transmitter

INDICATE FACTORY MUTUAL RESEARCH JOB IDENTIFICATION(S) AFFECTED
J.I. 3W0A4.AX

REVISION DETAILS

- Analog Board - GLL895
The Transil diode was changed from SMBJ6,5A to SM6T7V5A
- The Terminal Block - GLL1015
A new option was included into item Filter 2nF 1000V 25A
The bill of material annex to schematic drawing was excluded and general components and Term Assembl list was included

DWG. NO. AFFECTED REV. NEW DWG. NO. REV.

102B-0278	05	102B-0278	06	<i>ok</i>
102B-0303	01	102B-0303	02	<i>ok</i>
		LM102-0338	00	<i>ok</i>
		LM102-0238	03	<i>ok</i>

REASON FOR CHANGE(S)/COMMENTS:

* The Transil diode was changed to reduce the leakage current in operational condition.

* This new option of filter is more inexpensive.
The material control system was changed to comply with production process.

BELOW FOR FACTORY MUTUAL RESEARCH USE

COMMENTS:

- change does not affect safety - diode has same size and ratings, capacitors are same size and ratings.
- updated CDL

REVISION REPORT J. I.	REVISION NOTICE NO. 201059-283-7	CLASS NO. 3610
FORWARD APPROVAL/SPECIFICATION TESTED AGREEMENT <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
REVISION ACCEPTED <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 Styracula
David Styracula
Technical Team Manager
Hazardous Locations