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APPROVAL REPORT

PRESSURE AND DIFFERENTIAL PRESSURE TRANSMITTER MV-LINE TYPE 20a0 T b c AND TYPE 2600T FOR HAZARDOUS (CLASSIFIED) LOCATIONS

Prepared for:

ABB Automation Products GmbH
Schillerstrasse 72
D-32425 Minden, Germany

Project ID: 3011340
Class 3610
Date: May 10, 2002

Factory Mutual Research Corporation
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An FM Global Affiliate

Pressure and Differential Pressure Transmitter
Mv-Line Type 20a0 T b c and Type 2600T
For Hazardous (Classified) Locations

May 10, 2002

from

ABB Automation Products GmbH
Schillerstrasse 72
D-32425 Minden, Germany

I INTRODUCTION

1.1 ABB Automation Products GmbH. (manufacturer) has requested Approval of the apparatus listed in section 1.4 to be in compliance with the applicable requirements of the following standards listed in section 1.3. ZELM Ex performed the examination and testing of the products for possible Factory Mutual Research Approval based on the inter-laboratory agreement between Factory Mutual Research and ZELM Ex.

1.2 This report may be reproduced only in its entirety and without modification.

1.3 **Standards:**

Title	Class Number	Date
Electrical Equipment for Use in Hazardous (Classified) Locations, General Requirements	3600	November 1998
Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, & III, Division 1 and Class I Zone 0 & 1 Hazardous (Classified) Locations	3610	October 1999
Nonincendive Electrical Equipment for Use in Class I and II, Division 2, and Class III, Divisions 1 and 2, Hazardous (Classified) Locations	3611	October 1999
Electrical and Electronic Test, Measuring and Process Control Equipment	3810 (Including Supplement #1)	March 1989 (July 1995)
Enclosures for Electrical Equipment (1000 Volts Maximum)	ANSI/NEMA 250	1991

1.4 **Listings:** The following was evaluated as Intrinsically safe, with Entity and FISCO parameters, for use in Class I, II, III Division 1, Groups A, B, C, D, E, F, G and Class I, Zone 0, Group IIC, in accordance with manufacturing's Control Drawing No. A 01 M 504 V; nonincendive with nonincendive field wiring for Class I, Division 2, Groups A, B, C, D and Class I, Zone 2, Group IIC, special protection for Class II, Division 2, Groups F, G, in accordance with manufacturing's Control Drawing No. A 01 M 504 V , Hazardous (Classified) Indoor/Outdoor (TYPE 4X) Locations. The product will appear in the Approval Guide as follows:

1.4.1 **20a0 T b c, MV-Line Pressure and Differential Pressure Transmitter**

IS/I, II, III/1/ABCDEFG/ T6, T4 Ta = 85 °C – A 01 M 504 V; Entity; Type 4X
I/0/AEx ia IIC/ T6, T4 Ta = 85 °C - A 01 M 504 V; FISCO
NI/I/2/ABCD/ T6, T4 Ta = 85 °C; - A 01 M 504 V
S/II, III/2/F,G/ T6, T4 Ta = 85 °C
Entity and Nonincendive Field Wiring Parameters:

Groups A, B, C, D, E, F, and G and Group IIC:	Vmax = 24V Imax = 250mA Pi = 1.2W Ci = 1nF Li = 10µH

FISCO Parameters:

Groups A, B, C, D, E, F, and G and Group IIC:	Vmax = 17.5V Imax = 360mA Pi = 2.52W
Groups C, D, E, F, and G and Group IIB:	Vmax = 17.5V Imax = 380mA Pi = 5.32W Ci = 1nF Li = 10µH

Maximum Entity, FISCO and Nonincendive Field Wiring Parameters: Supply and Sensor Terminals
Voc = 10.5 V, Isc = 1.5 mA, Ca = 2.4µF, La = 1H, Po = 4 mW

a = 1or 2
b = A, C, D, or G
c = Profibus-PA or Foundation Fieldbus

1.4.2 **26abcdefghijklmnopqrst, MV-Line Pressure and Differential Pressure Transmitter**

IS/I, II, III/1/ABCDEFG/ T6, T4 Ta = 85 °C – A 01 M 504 V; Entity; Type 4X
I/0/AEx ia IIC/ T6, T4 Ta = 85 °C - A 01 M 504 V; FISCO
NI/I/2/ABCD/ T6, T4 Ta = 85 °C; - A 01 M 504 V
S/II, III/2/F,G/ T6, T4 Ta = 85 °C
Entity and Nonincendive Field Wiring Parameters:

Groups A, B, C, D, E, F, and G and Group IIC:	Vmax = 24V Imax = 250mA Pi = 1.2W Ci = 1nF Li = 10µH

FISCO Parameters:

Groups A, B, C, D, E, F, and G and Group IIC:	Vmax = 17.5V Imax = 360mA Pi = 2.52W
Groups C, D, E, F, and G and Group IIB:	Vmax = 17.5V Imax = 380mA Pi = 5.32W Ci = 1nF Li = 10µH

Maximum Entity, FISCO and Nonincendive Field Wiring Parameters: Supply and Sensor Terminals
Voc = 10.5 V, Isc = 1.5 mA, Ca = 2.4µF, La = 1H, Po = 4 mW

a = performance 3, 5, 7, 9
b = measure type and construction A, B, C, D, J, G, V
c = application C, H, R, S
d = upper range limits A, C, F, L, N, R, U, V
e = static pressure range 1, 2, 3, 4, M, Y, C, Z, T, S
f = TR: diaphragm & fluid N, A, S, J, E, G, U, B, H, P, F, K, Y, V, C, M, R, D, T
g = flange material & connection A, B, C, D, E, F, G, H, L, P, R
h = connection material & type B, T, N, A, P, V, Q, U, S, E, K, W, C, F, D, Z, Y, R
i = connection gasket 5, 6, 8, N
j = high side: flange, rating size A, B, D, E, G, H, J, K, M, N, P, Q, R, S
l = high side: flange mat & form E, L, M, N
m = high side: ext size & material 1, 2, 3, 4, 5, 6, 9, F
n = high side: isolating diaphragm G, H, K, S, T, Y
o = high side: fill fluid H, N, P, S, V, W
p = low side: diaphragm & fluid N, A, S, P, F, K, Y, V, C, M, R, D, T
q = low side: flanges & connection A, B, C, D, E, F, G, H, L, P, R
r = bolts and gasket 1, 2, 3, 4, 5, 6, N, R
s = electronic housing A, B, E, G, J, K, S, T, W, Z
t = communication 2, 3, F, P

1.5 As described in this report, the construction of the Pressure and Differential pressure Transmitter provides the degree of protection against electrical shock, fire, and injury required for hazardous (classified) locations.

II DESCRIPTION

2.1 This report is Factory Mutual Research's addition to ZELM Ex's report No. 0080117 for the manufacturer's Mv-Line Type 20a0 T b c and Type 2600T. The Pressure and Differential pressure Transmitter MV-Line is used for measuring and converting physical values like pressure, differential pressure and temperature into digital standard signals (Profibus-PA or Foundation fieldbus). It can be supplied by an intrinsically safe linear barrier or by a FISCO supply with rectangular or trapezoidal characteristics.

2.2 For additional descriptive information, reference the original ZELM Ex report No.0080117.

III EXAMINATIONS AND TESTS

The attached ZELM Ex test report, No. 0080117, describes the examination and testing that ZELM Ex performed towards Factory Mutual Research Approval of the products listed in Section 1.4 of this report. A review of the ZELM Ex report found the following examination and testing of the Mv-Line Type 20a0 T b c and Type 2600T to be satisfactory for a Factory Mutual Research Approval. All data is on file at Factory Mutual Research along with other documents and correspondence applicable to this program.

- Intrinsically safe, with Entity and FISCO parameters, for use in Class I, II, III Division 1, Groups A, B, C, D, E, F, G and Class I Zone 0 Group IIC, in accordance with manufacturing's Control Drawing No. A 01 M 504 V; hazardous (classified) locations.
- Nonincendive with Nonincendive Field wiring evaluation for Class I, Division 2, Groups A, B, C and D; hazardous (classified) locations.
- Suitable for Class II, Division 2, Groups F and G, Class III, Division 1; hazardous (classified) locations.
- Process pressure testing on the Mv-Line Type 20a0 T b c and Type 2600T for a maximum working pressure rating of 100 bar (1500 psi).
- Environmental Type 4X examination and testing.
- Examination and testing to verify protection against fire, injury and shock.

IV MARKING

The following information appears on the attached drawing number V15712 X125 (4) revision 4 and the apparatus identified in Section 1.4 that meets Standard requirements

- Manufacturer's name, address, model code and serial number
- Maximum input and output ratings
- Maximum ambient temperature and temperature classification
- Hazardous area classification
- The reference to control drawing no. A 01 M 504 V
- The Factory Mutual Research mark of Approval

V REMARKS

5.1 Installations shall comply with the relevant requirements of the latest edition of the National Electrical Code (ANSI/NFPA 70).

5.2 Installations shall comply with the latest edition the manufacturer's instruction manual.

5.3 Control room equipment connected to intrinsically safe associated apparatus should not use or generate more than 250 V rms or DC.

5.4 See ANSI/ISA RP12.6, Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations for guidance on the installation of intrinsically safe apparatus and systems.

VI FACILITIES AND PROCEDURES AUDIT

The ABB Automation Products GmbH manufacturing site in Minden, Germany is subject to follow-up audit inspections. The facility and quality control procedures in place have, previously, been found satisfactory to manufacture products identical to that tested and Approved.

VII MANUFACTURERS RESPONSIBILITIES

The manufacturer shall advise Factory Mutual Research of all proposed changes to the documents listed in Section VIII via a Form 797, Approved Product Revision Report.

VIII DOCUMENTATION

The following drawings depict the Mv-Line Type 20a0 T b c and Type 2600T. These Drawings are on file at Factory Mutual Research in critical document file No. 3011340.

Title	Revision	Document No.
Main Board Fieldbus	06/07/01	V15712 X122(1)
Characterization Board p-piezo	03/30/01	V15712 X114(1)
Characterization Board dp-piezo	03/30/01	V15712 X115(1)
Characterization Board p-cap	05/29/01	V15712 X116(1)
Characterization Board dp-cap	05/04/01	V15712 X117(1)
Characterization Board hp-piezo	04/05/01	V15712 X118(1)
Temp. Board Multivariable	04/05/01	V15712 X119(2)
Connection Board Fieldbus	05/31/01	V15712 X121(2)
LCD-Display	05/29/01	V15712 X120(2)
Type plate	4	V15712 X125(4)
Block diagram MV 2000 Fieldbus	04/05/01	V15712 X113(3)
Transmitter MV 2000T.	04/02/01	V15712 X123(1)
MV20..T. with remote seal	05/23/01	V15712 X127(1)
FM Control Drawing 2000 T	03/15/02	A 01 M 504 V
Ordering Information (8 pages)	05/11/01	V15712 X126(4)
Transmitter Coding (8 pages)	03/15/02	V15712 X174
Component Lists	04/11/01	V15712 X114 P
Component Lists	04/11/01	V15712 X115 P

Title	Revision	Document No.
Component Lists	04/11/01	V15712 X116 P
Component Lists	04/11/01	V15712 X117 P
Component Lists	04/11/01	V15712 X118 P
Component Lists	04/11/01	V15712 X119 P
Component Lists	04/11/01	V15712 X120 P
Component Lists	04/11/01	V15712 X121 P
Component Lists	04/11/01	V15712 X122 P
Component Lists	04/11/01	V15712 X1xx P
Component Lists	04/11/01	V15712 X1xx P

IX CONCLUSION

The apparatus listed in Section 1.4 meets Factory Mutual Research requirements. Approval is effective when the Approval Agreement is signed and received by Factory Mutual Research.

EXAMINATION AND TESTING BY:

- ZELM Ex - Burkhard Gorks

EXAMINATION BY:

- Factory Mutual Research - Patrick J. Byrne

ATTACHMENTS:

- ZELM Ex Test Report Number 0080117, dated April 23, 2002
- Product Label Drawing, Number V15712 X125 Revision 4
- Installation Drawing Number A01M504V, dated April 15, 2002

REPORT BY:

Patrick J. Byrne
Engineer
Electrical Section

REPORT REVIEWED BY:

Aaron Coleman
Engineer
Electrical Section

FISCO rules

The FISCO Concept allows the interconnection of intrinsically safe apparatus to associated apparatus not specifically examined in such combination. The criterion for such interconnection is that the voltage (Vmax), the current (Imax) and the power (Pi) which intrinsically safe apparatus can receive and remain intrinsically safe, considering faults, must be equal or greater than the voltage (Uo, Voc, Vt), the current (Io, Isc, It,) and the power (Po) which can be provided by the associated apparatus (supply unit). In addition, the maximum unprotected residual capacitance (Ci) and inductance (Li) of each apparatus (other than the terminators) connected to the Fieldbus must be less than or equal to 5 nF and 10 µH respectively.
In each I.S. Fieldbus segment only one active source, normally the associated apparatus, is allowed to provide the necessary power for the Fieldbus system. The allowed voltage (Uo, Voc, Vt) of the associated apparatus used to supply the bus must be limited to the range of 14V d.c. to 24V d.c. All other equipment connected to the bus cable has to be passive, meaning that the apparatus is not allowed to provide energy to the system, except to a leakage current of 50 µA for each connected device. Separately powered equipment needs a galvanic isolation to insure that the intrinsically safe Fieldbus circuit remains passive.
The cable used to interconnect the devices needs to comply with the following parameters:
Loop resistance R': 15 ...150 Ω/ km
Inductance per unit length L': 0.4...1mH / km
Capacitance per unit length C': 80 ...200 nF / km
C' = C' line/line + 0.5 C' line/screen, if both lines are floating
or
C'= C' line/line + C' line/screen, if the screen is connected to one line
Length of spur Cable: max. 30 m
Length of trunk cable: max. 1 km
Length of splice: max. 1 m
Terminators
At each end of the trunk cable an approved line terminator with the following parameters is suitable:
R = 90 ...100 Ω
C = 0 ...2.2 µF.
System evaluation
The number of passive devices like transmitters, actuators, connected to a single bus segment is not limited due to I.S. Reasons. Furthermore, if the above rules are respected, the inductance and capacitance of the cable need not to be considered and will not impair the intrinsic safety of the installation.

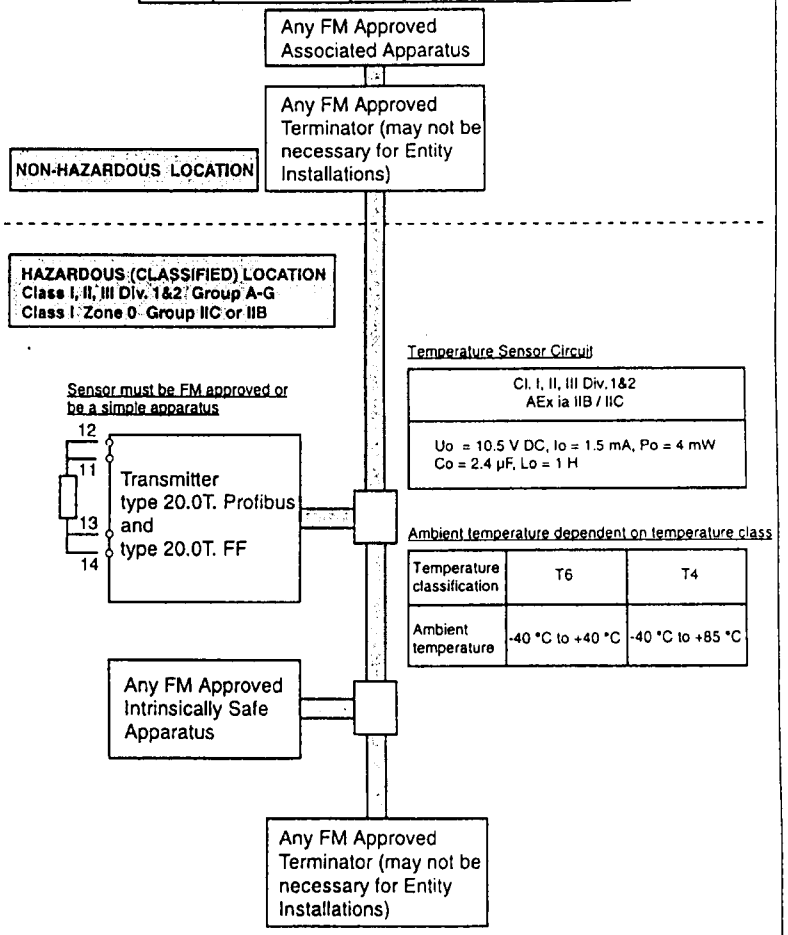
Installation Notes For FISCO and Entity Concepts:

1. The Intrinsic Safety Entity concept allows the interconnection of FM Approved Intrinsically safe devices with entity parameters not specifically examined in combination as a system when:
   Uo or Voc or Vt ≤Vmax, Io or Isc or It ≤Imax, Po ≤ Pi. Ca or Co ≥ΣCi + ΣCcable,
   For inductance use either La or Lo ≥ΣLi + ΣLcable or Lc / Rc ≤(La / Ra or Lo / Ro) and Li / Ri ≤(La / Ra or Lo / Ro)
2. The Intrinsic Safety FISCO concept allows the interconnection of FM Approved Intrinsically safe devices with FISCO parameters not specifically examined in combination as a system when: Uo or Voc or Vt ≤Vmax, Io or Isc or It ≤Imax, Po ≤Pi.
3. Control equipment connected to the Associated Apparatus must not use or generate more than 250 Vrms or Vdc.
4. Installation should be in accordance with ANSI/ISA RP12.6 (except chapter 5 for FISCO Installations) "Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations" and the National Electrical Code® (ANSI/NFPA 70) Sections 504 and 505.
5. The configuration of associated Apparatus must be Factory Mutual Research Approved under the associated concept.
6. Associated Apparatus manufacturer's installation drawing must be followed when installing this equipment.
7. The Transmitter Type 20.0T. Series are Approved for Class I, Zone 0, applications. If connecting AEx[ib] associated Apparatus or AEx ib I.S. Apparatus to the Product Series the I.S. circuit is only suitable for Class I, Zone 1, or Class I, Zone 2, and is not suitable for Class I, Zone 0 or Class I, Division 1, Hazardous (Classified) Locations.
8. No revision to drawing without prior Factory Mutual Research Approval.
9. Simple Apparatus is defined as a device that does not generates more than 1.5V, 0.1A or 25mW.

NONINCENDIVE, CLASS I, DIV. 2, GROUP A, B, C, D AND FOR CLASS II AND III, DIV. 1&2, GROUP E, F, G HAZARDOUS LOCATION INSTALLATION.

1. Install per National Electrical Code (NEC) using threaded metal conduit. Intrinsic safety barrier required. Max. Supply voltage 30 V. For T-code see table.
2. A dust tight seal must be used at the conduit entry when the transmitter is used in a Class II & III Location.
3. WARNING: Explosion Hazard - do not disconnect equipment unless power has been switched off or the area is known to be Non-Hazardous.
   WARNING: Substitution of components may impair suitability for hazardous locations.

Concept	Groups	Vmax (V)	Imax (mA)	Pmax (W)	Ci (nF)	Li (µH)
Entity	IIC / ABCDEFG	24	250	1.2	1	10
FISCO	IIC / ABCDEFG	17.5	360	2.52		
FISCO	IIB / CDEFG	17.5	380	5.32		



TITLE:
FM Control Drawing 2000T
INTRINSICALLY SAFE INSTALLATION

ABB Automation Products GmbH

PART NO: A 01 M 504 V

DRAWN S. WINTER
CHKD
APPV
DATE April 15 2007
SHT 1 of 1 REV 03

FM Approvals
Member of the FM Global Group

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CERTIFICATE OF COMPLIANCE

HAZARDOUS LOCATION ELECTRICAL EQUIPMENT

This certificate is issued for the following equipment:

20a0 T b c, MV-Line Pressure and Differential Pressure Transmitter

IS/I, II, III/1/ABCDEFG/ T6, T4 Ta = 85 °C – A 01 M 504 V; Entity; Type 4X
I/0/AEx ia IIC/ T6, T4 Ta = 85 °C - A 01 M 504 V; FISCO
NI/I/2/ABCD/ T6, T4 Ta = 85 °C; - A 01 M 504 V
S/II, III/2/F,G/ T6 , T4 Ta = 85 °C
Entity and Nonincendive Field Wiring Parameters:
Groups A, B, C, D, E, F, and G and Group IIC: Vmax = 24V Imax = 250mA Pi = 1.2W
Ci = 1nF Li = 10μH

FISCO Parameters:
Groups A, B, C, D, E, F, and G and Group IIC: Vmax = 17.5V Imax = 360mA Pi = 2.52W
Groups C, D, E, F, and G and Group IIB: Vmax = 17.5V Imax = 380mA Pi = 5.32W
Ci = 1nF Li = 10μH

Maximum Entity, FISCO and Nonincendive Field Wiring Parameters: Supply and Sensor Terminals
Voc = 10.5 V, Isc = 1.5 mA, Ca = 2.4μF, La = 1H, Po = 4 mW

a = 1or 2
b = A, C, D, or G
c = Profibus-PA or Foundation Fieldbus

26 abcdefghjlmnopqrst [u], 2600T Pressure Transmitter.

IS/I, II, III/1/ABCDEFG/ T6, T4 Ta = 85 °C – A 01 M 504 V; Entity; Type 4X
I/0/AEx ia IIC/ T6, T4 Ta = 85 °C - A 01 M 504 V; FISCO
NI/I/2/ABCD/ T6, T4 Ta = 85 °C; - A 01 M 504 V
S/II, III/2/F,G/ T6, T4 Ta = 85 °C
Entity and Nonincendive Field Wiring Parameters:
Groups A, B, C, D, E, F, and G and Group IIC: Vmax = 24V Imax = 250mA Pi = 1.2W
Ci = 1nF Li = 10μH
FISCO Parameters:
Groups A, B, C, D, E, F, and G and Group IIC: Vmax = 17.5V Imax = 360mA Pi = 2.52W

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Groups C, D, E, F, and G and Group IIB: Vmax = 17.5V Imax = 380mA Pi = 5.32W
Ci = 1nF Li = 10µH
Maximum Entity, FISCO and Nonincendive Field Wiring Parameters: Supply and Sensor Terminals
Voc = 10.5 V, Isc = 1.5 mA, Ca = 2.4µF, La = 1H, Po = 4 mW

- A = Performance: 3, 5, 7, or 9
- b = Measuring type: A, B, C, D, J, G, or V
- c = Application: C, H, R, or S
- d = Upper Range Limit: A, C, D, F, L, N, R, U, or V
- e = Static Pressure: 1, 2, 3, 4, M, Y, C, Z, T, or S
- f = TR Diaphragm & Fluid: N, A, S, J, E, G, U, B, H, P, F, K, Y, V, C, M, R, D or T
- g = Flange Material & Connection: A, B, C, D, E, F, G, H, L, P, Q, or R
- h = Connection Material & Type: B, T, N, A, P, V, Q, U, S, E, K, W, C, F, D, Z, Y, or R
- i = Connection Gasket: 5, 6, 8, or N
- j = High Side: Flange, Rating Size: A, B, D, E, G, H, J, K, M, N, P, Q, R, or S
- l = High Side: Flange Mat &Form: E, L, M, or N
- m = High Side EXT Size and Material: 1, 2, 3, 4, 5, 6, 9, or F
- n = High Side: Isolating Diaphragm: G; H; K; S; T; or Y
- o = High Side: Fill Fuild: H,N, P, S, V, or W
- p = Low Side Diaphragm & Fluid: N, A, S, P, F, K, Y, V, C, M, R, D, or T
- q = Low Side: Flanges & Connection: A, B, C, D, E, F, G, H, L, P, Q or R
- r = Bolts & Gasket: 1, 2, 3, 4, 5, 6, N, or R
- s = Electronic Housing: A, B, C, D, E, G, H, J, K, L, M, N, P, R, S, T, U, V, W, Y, or Z
- t = Communication: 2, 3, F, P
- u = Options (One or more): A1, A2, A3, B2, B4, C1, C2, C3, C4, C5, C6, C7, E4, E6, EA, EC, F1, H1, H2, H3, L1, M1, M2, M3, M4, P1, P2, P3, P4, Q1, Q2, T1, T2, T3, T4, T5, T6, T7, T8, T9, V1, V2, V3, V4, V5, V6, V7, V8, V9.

Equipment Ratings:

Intrinsically safe, with Entity and FISCO parameters, for use in Class I, II, III Division 1, Groups A, B, C, D, E, F, G and Class I Zone 0 Group IIC, in accordance with manufacturing's Control Drawing No. A 01 M 504 V;
nonincendive with nonincendive field wiring for Class I, II, III Division 2, Groups A, B, C, D, F, G and Class I, Zone 2, Group IIC, in accordance with manufacturing's Control Drawing No. A 01 M 504 V
special protection for Class II, Division 2, Groups F, G,
Hazardous (Classified) Indoor/Outdoor (TYPE 4X) Locations

FM Approved for:

ABB Automation Products
Schillerstraße 72
32425 Minden, Germany

FM Approvals℠

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This certifies that the equipment described has been found to comply with the following Approval Standards and other documents:

Class 3600	1998
Class 3610	1999
Class 3810	2005
ISA-S12.0.01	1991
ANSI/NEMA 250	1991

Original Project ID: 3011340 Approval Granted: October 8, 2002

Subsequent Revision Reports / Date Approval Amended

Report Number	Date	Report Number	Date
061218	6/15/07		

FM Approvals LLC

Robert L. Martell, Jr.
Assistant Vice President

6/15/07
Date