

# Descriptive Report and Test Results

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	Contents:	Certificate of Compliance - Pages 1 to 3			
		Supplement to Certificate of Compliance - Page 1 to 2			
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# **PRODUCTS**

CLASS 2258 03 - PROCESS CONTROL EQUIPMENT - Intrinsically Safe And Non-Incendive Equipment - For Hazardous Locations

CLASS 2258 83 - PROCESS CONTROL EQUIPMENT - Intrinsically Safe And Non-Incendive Equipment- For Hazardous Locations - To U.S. Requirements

## Class I, Division 1, Groups C & D:

## Part A:

Smart-Alek data logger & transmitter, Models SA100, SA1.X ORBCOMM, SA200, SA1.X CDPD (MWP 3000 or 10,000 psi), Battery Operated; provides Intrinsically Safe connections for passive antenna Models 550 and 551, passive RTD assembly Model 552, and Intrinsically Safe solar panel Model 522, rated 21.0 Voc, 0.37 A Isc, 5 W max.

## Part B:

Smart-Alek data logger & transmitter, Model SA2000 (MWP 10,000 psi); Single Seal for SA2000 Smart-Alek with approved sensors; Battery Operated; provides Intrinsically Safe connections for passive antenna Models 65X, passive RTD assembly Model 61X, and non-incendive Class I, Div. 2 rated solar panels Model 622, rated 24.8 Voc, 0.396 A Isc, 5 W max; Model 620, rated 22.9 Voc, 0.39 A Isc, 5 W max; Model 621, rated 21.9 Voc, 0.44 A Isc, 5 W max or 2 X 5W option when connected to Model 620 or 621 Solar Panels per drawing 12397 with Model 641 IS Barrier; may provide non-incendive connections for Class I, Div. 2 rated Model 660 Pressure Sensor (MWP 0-400 Bar); may provide intrinsically safe connections for Class I, Div. 1 rated Model 661 Pressure Sensor (MWP 0-400 Bar); may provide intrinsically safe 2 wire RS485 data connection and Pulse / Contact I/O when connected per drawing 12397, may provide non-incendive connections to Class I, Div. 2 rated Model 63X external modem unit. SA2000 ambient rated -40°C to +60°C

# Part E:

External Modem Model 631, ambient rated -40°C to +60°C internally battery operated provide intrinsically safe connections to Div.1 rated Model SA2000, provides non-incendive connections for passive antenna Models 65X and solar panel Model 622, 620 or 621 when connected per drawing 12397.

<u>Note</u>: The X in the RTD and Antenna model designation above may be any alphanumeric character that denotes antenna style or RTD probe length.

#### Class I, Division 2, Groups C & D:

# Part C:

Smart-Alek data logger & transmitter, Model SA2000 (MWP 10,000 psi); Single Seal for SA2000 Smart-Alek with approved sensors; Internally Battery Operated or Externally Powered By Model 110 Non-Incendive Battery Unit; provides non-incendive connections for Class I, Div. 2 rated passive RTD assembly Model 61X, Intrinsically Safe connections for passive antenna Models 65X and non-incendive Class I, Div. 2 rated solar panel Model 622, rated 24.8 Voc, 0.396 A Isc, 5 W max , Model 620, rated 21.0 Voc, 0.37 A Isc, 5 W max OR Model 621, rated 21.9 Voc, 0.44 A Isc. SA2000 ambient rated -40°C to +60°C

#### Part D:

External Modem Model 630, Enc Type 4, internally battery operated provide intrinsically safe connections to Div.1 rated Model SA2000, provides non-incendive connections for passive antenna Models 65X and solar panel Model 622, rated 24.8 Voc, 0.396 A Isc, 5 W max, Model 620, rated 22.9 Voc, 0.39 A Isc, 5 W max OR Model 621, rated 21.9 Voc, 0.44 A Isc.

# Part F:

External Battery Model 690, Enc Type 4, internally battery operated provide intrinsically safe connections to Div.1 rated Model SA2000, provides non-incendive connections for passive antenna Models 65X and solar panel Model 622, Model 620 OR Model 621 when connected per drawing 12397.

<u>Note</u>: The X in the RTD and Antenna model designation above may be any alphanumeric character that denotes antenna style or RTD probe length.

# **APPLICABLE REQUIREMENTS**

CSA Standard C22.2 No. 0-M1991 - General Requireme	nts Canadian Electrical Code Part II.
CSA Standard C22.2 No.0.4-M2004 - Bonding and Groun	ding of Electrical Equipment (Protective Grounding)
CSA Standard C22.2 No. 0.5-M1982 - Threaded Conduit E	intries
CSA Standard C22.2 No. 30-M1986 - Explosion-Proof En	closures for Use in Class I Hazardous Locations
CSA Standard C22.2 No.142-M1987 - Process Control Equ	ipment
CSA Standard C22.2 No. 157-M1992 - Intrinsically Safe ar	d Non-Incendive Equipment for Use in Hazardous
Locations	
CSA Standard C22.2 No. 213-M1987 - Non-Incendive Elect	trical Equipment for Use in Class I, Division 2
Hazardous Locatio	18
UL Standard 508, Seventeenth Edition- Industrial Control E	quipment
UL Standard 698, Twelfth Edition - Industrial Control Equ	pment for Use in Hazardous (Classified) Locations
UL Standard 913, Seventh Edition - Intrinsically Safe Appa	ratus and Associated Apparatus for use in Class I, II,
III, Division 1, Hazard	ous (Classified) Locations.
UL Standard 1203, Fourth Edition - ExplosionProof and De	stIgnitionProof Electrical Equipment for Use in
Hazardous (Classified	) Locations
UL Standard 1604, Third Edition - Electrical Equipment f	or Use in Class I and II, Division 2, And Class III
Hazardous (Classified	) Locations.
ANSI/ISA 12.27.01-2003 - Requirements for Proc	ess Sealing Between Electrical Systems and
Flammable or Combu	stible Process Fluids.

# MARKINGS

#### PART A TRANSMITTER:

- (1) Submittor's name, trademark, or the CSA file number (adjacent the CSA Mark).
- (2) Model designation.
- (3) Date code / Serial number traceable to month and year of manufacture.
- (4) 12 V dc internal batteries P/Ns 520902 and 520906, this replacement part number shall appear also on the battery packs.
- (5) Hazardous Location designations Class I, Div. 1, Groups C & D.
- (6) The designation: [Exia], ASSOCIATED EQUIPMENT provides IS circuits for connection to Model 552 RTD, Model 550/551 Antenna when powered by internal batteries and/or connected to Model 522 Solar Panel".
- (7) The CSA Mark with the C/US Qualifiers.
- (8) The following bilingual cautions:
   WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY: and,
   AVERTISSEMENT: LA SUBSTITUTION DE COMPOSANTS PEUT COMPROMETTRE LA
   SECURITE INTRINSEQUE".
- (9) The following appears on a permanent nameplate or tag adjacent to the yellow connector housing: WARNING: DO NOT USE THIS CONNECTOR FOR DATA CONNECTIONS UNLESS THE AREA IS KNOWN TO BE NON-HAZARDOUS and AVERTISSEMENT: NE PAS UTILIZER CE CONNECTOR POUR LA LIAISON D'INFORMATION DANS UNE REGION HASARDEUSE
- (10) WARNING: TO PREVENT IGNITION OF A HAZARDOUS ATMOSPHERE, BATTERIES MUST ONLY BE CHANGED IN AN AREA KNOWN TO BE NON-HAZARDOUS" and "AVERTISSEMENT: AFIN DE PRÉVENIR L'INFLAMMATION D'ATMOSPHÈRES DANGEREUS, NE CHANGER LES BATTERIES QUE DANS DES EMPLACEMENTS DÉSIGNÉS NON DANGERUEX"
- (11) Maximum Working pressure marked on the pressure transducer.

# PART B TRANSMITTER: Same as Part A above except:

- (4) 6 V dc internal batteries P/N 2EXL4138 or ZI P/N 11740 OR 8 V dc internal batteries ZI P/N 12345, this replacement part number shall appear also on the battery pack.
- (6) The designation: [Exia], ASSOCIATED EQUIPMENT provides IS circuits for connection to Model 61X RTD, Model 65X Antenna when powered by internal batteries and/or connected to Model 620 Solar Panel".
- (9) The following appears on a permanent nameplate or tag adjacent to the I/O cable connector housing: WARNING: DO NOT USE THIS CONNECTOR FOR CONNECTIONS THAT ARE NOT APPROVED FOR USE WITH THE SA2000. AVERTISSEMENT: N'UTILISEZ PAS CE CONNECTEUR POUR DES CONNEXIONS QUI NE SONT PAS APPROUVEES POUR USAGE AVEC SA2000.
- (10) WARNING: TO PREVENT IGNITION OF A HAZARDOUS ATMOSPHERE:

   KEEP COVER TIGHT. OPEN ONLY WHEN AREA IS KNOWN TO BE NON-HAZARDOUS.-ONLY CHANGE BATTERIES IN AN AREA KNOWN TO BE NON-HAZARDOUS.AVERTISSEMENT: AFIN DE PRÉÉVENIR L'INFLAMMATION D'ATMOSPHÈÈRES HASARDEUSES:- GARDEZ COUVERCLE SERRÉÉ. OUVREZ SEULEMENT SI L'ENDROIT EST DESIGNÉÉENON-HASARD.- NE PAS CHANGEZ BATTERIES QUE DANS ENDROITS DÉÉSIGNÉÉS NON-HASARD.
- (11) Maximum Working pressure marked on the pressure transducer or on the main nameplate.
- (12) The term "Single Seal" for the SA2000 Smart-Alek with approved sensors.
- (13) "Process Temperature Range" for the SA2000 Smart-Alek with approved sensors.
- (14) Ambient temperature range  $-40^{\circ}$ C to  $+60^{\circ}$ C.

# 550, 551, 65X ANTENNA and 552, 61X RTD

- (1) Submittor's name, trademark, or the CSA file number (adjacent the CSA Mark).
- (2) Model designation.
- (3) Date code / Serial number traceable to month and year of manufacture.
- (4) The designation: Exia, INTRINSICALLY SAFE for use in Class I, Division 1, Groups C and D when connected to Model SA100 / SA200 or Model SA2000.
- (5) The CSA Mark with the C/US Qualifiers.
- The following bilingual cautions:
   WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY: and, AVERTISSEMENT: LA SUBSTITUTION DE COMPOSANTS PEUT COMPROMETTRE LA SECURITE INTRINSEQUE".

## 522, 620, 621, 622 SOLAR PANEL

- (1) Submittor's name, trademark, or the CSA file number (adjacent the CSA Mark).
- (2) Model designation.
- (3) Hazardous Location designations Class I, Div. 2, Groups C & D.
- (4) Date code / Serial number traceable to month and year of manufacture.
- (5) Electrical ratings of 22.9 Voc, 0.39 A Isc, 5 Wmax (Models 522, 620) OR 21.9 Voc, 0.44 A Isc, 5 Wmax (Model 621) OR 24.8 Voc, 0.396 A Isc, 5 Wmax (Model 622).
- (6) Temperature Code T3C (Models 621, 622 Only)
- (7) The designation: [Exia], ASSOCIATED EQUIPMENT provides IS circuits for Division 1 when installed as per Drawing 12397.
- (8) The CSA Mark with the C/US Qualifiers.
- (9) The following bilingual cautions:
   WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY: and,
   AVERTISSEMENT: LA SUBSTITUTION DE COMPOSANTS PEUT COMPROMETTRE LA
   SECURITE INTRINSEQUE".

## Model 641 10 W Solar Panel Option IS Barrier

- (1) Submittor's name, trademark, or the CSA file number (adjacent the CSA Mark).
- (2) Model designation.
- (3) Hazardous Location designations Class I, Div. 2, Groups C & D.
- (4) Temperature Code T4.
- (5) Date code / Serial number traceable to month and year of manufacture.
- (6) Electrical ratings of:
  21.9 Voc, 0.490 A Isc, 10W Max. (Model 621 Solar Panel)
  22.9 Voc, 0.466 A Isc, 10W Max. (Model 620 Solar Panel)
- (7) The designation: [Exia], ASSOCIATED EQUIPMENT provides IS circuits for Division 1 when installed as per Drawing 12397.
- (8) The CSA Mark with the C/US Qualifiers.
- (9) The following bilingual cautions:
   WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY: and,
   AVERTISSEMENT: LA SUBSTITUTION DE COMPOSANTS PEUT COMPROMETTRE LA SECURITE INTRINSEQUE".

## Class I, Division 2 Model 660 Pressure Sensor for Use with Div. 1 Rated Model SA2000 Transmitter:

- (1) Submittor's name, trademark, or the CSA file number (adjacent the CSA Mark).
- (2) Model designation.
- (3) Date code / Serial number traceable to month and year of manufacture.
- (4) Maximum working pressure 0-400 BAR
- (5) The term "Single Seal"
- (6) Process Temperature Range  $-40^{\circ}$ C to  $+85^{\circ}$ C
- (7) The CSA Mark with the C/US Qualifiers.
- (8) The designation: "Non-incendive for Class I, Division 2, Groups C & D when connected to Model SA2000 as per drawing 12397"

# PART C TRANSMITTER: Same Part B above except:

- (5) Hazardous Location designations Class I, Div. 1 & 2, Groups C & D.
- (6) The designation: [Exia], ASSOCIATED EQUIPMENT provides IS circuits for Division 1 when installed as per Drawing 12397; Provides Non-Incendive circuits for Division 2 when installed as per Drawing 12397.

# Class I, Division 2 Model 61X RTD For Use With Div. 2 Rated Model SA2000 Transmitter: Same as above except:

(6) The designation: "Non-incendive for Class I, Division 2, Groups C & D when connected to Class I, Division 2 rated Model SA2000"
 "WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2" and "AVERTISSEMENT - RISQUE D'EXPLOSION - LA SUBSTITUTION DE COMPOSANTS PEUT RENDRE CE MATERIEL INACCEPTABLE POUR LES EMPLACEMENTS DE CLASSE I, DIVISION 2"

# PART D Model 630 External Div. 2 Modem:

- (1) Submittor's name, trademark, or the CSA file number (adjacent the CSA Mark).
- (2) Model designation.
- (3) Date code / Serial number traceable to month and year of manufacture.
- (4) Electrical ratings of 22.9 Voc, 0.39 A Isc, 5 Wmax when Model 620 solar panel is integral to unit.
- (5) 8 V dc internal batteries ZI P/N 12345, this replacement part number shall appear also on the battery pack.
- (6) The CSA Mark with the C/US Qualifiers.
- (7) Enclosure rating of Type 4 or equiv.
- (8) The designation: "Provides I.S. circuits for Division 1 when connected to Model SA2000 as per drawing 12397"
- (9) WARNING: EXPLOSION HAZARD

– DO NOT DISCONNECT EQUIPMENT AND ASSOCIATED CONNECTORS OR REPLACE MODEM UNLESS POWER HAS BEEN SWITCHED OFF OR AREA IS KNOWN TO BE NON-HAZARDOUS.

– SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2, AND MAY IMPAIR INTRINSIC SAFETY.

- ONLY CHANGE BATTERIES IN AN AREA KNOWN TO BE NON-HAZARDOUS.

AVERTISSEMENT: RISQUE D'EXPLOSION

– AVANT DÉCONNECTER L'EQUIPMENT ET CONNECTEURS ASSOCIES OU REPLACER LE MODEM, COUPER LE COURANT OU S'ASSURER QUE L'EMPLACEMENT EST DÉSIGNÉ NON DANGEREUX.  – LA SUBSTITUTION DE COMPOSANTS PEUT RENDRE CE MATÉRIEL INACCEPTABLE POUR LES EMPLACEMENTS DE CLASSE I, DIVISION 2, ET PEUT COMPROMETTRE LA SÉCURITÉ INTRINSÈQUE.
 – NE PAS CHANGEZ BATTERIES QUE DANS ENDROITS DÉSIGNÉS NON-HASARD.

## PART E Model 631 Div.1 Modem:

- (1) Submittor's name, trademark, or the CSA file number (adjacent the CSA Mark).
- (2) Model designation.
- (3) Date code / Serial number traceable to month and year of manufacture.
- (4) 8 V dc internal batteries ZI P/N 12345, this replacement part number shall appear also on the battery pack.
- (5) Hazardous Location designations Class I, Div. 1, Groups C & D.
- (6) The designation: [Exia], ASSOCIATED EQUIPMENT provides IS circuits for Division 1 when installed as per Drawing 12397; Provides Non-Incendive circuits for Division 2 when installed as per Drawing 12397.
- (7) WARNING: TO PREVENT IGNITION OF A HAZARDOUS ATMOSPHERE:

   KEEP COVER TIGHT. OPEN ONLY WHEN AREA IS KNOWN TO BE NON-HAZARDOUS.-ONLY CHANGE BATTERIES IN AN AREA KNOWN TO BE NON-HAZARDOUS.AVERTISSEMENT: AFIN DE PRÉVENIR L'INFLAMMATION
   D'ATMOSPHÈRES HASARDEUSES:- GARDEZ COUVERCLE SERRÉ. OUVREZ SEULEMENT SI L'ENDROIT EST DESIGNÉENON-HASARD.- NE PAS CHANGEZ BATTERIES QUE DANS ENDROITS DÉSIGNÉÉS NON-HASARD.
- (8) WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY: and, AVERTISSEMENT: LA SUBSTITUTION DE COMPOSANTS PEUT COMPROMETTRE LA SÉCURITÉ INTRINSÈQUE".
- (9) Ambient temperature range  $-40^{\circ}$ C to  $+60^{\circ}$ C for SA2000

# PART F Model 690 External Div. 2 Battery:

- (1) Submittor's name, trademark, or the CSA file number (adjacent the CSA Mark).
- (2) Model designation.
- (3) Date code / Serial number traceable to month and year of manufacture.
- (4) 12 Vdc internal batteries: 12 V / 30 Ah (P/N 12942) or 12 V / 60 Ah (P/N 12943), this replacement part number shall appear also on the battery pack.
- (5) The CSA Mark with the C/US Qualifiers.
- (6) Enclosure rating of Type 4 or equiv.
- (7) The designation: "Provides I.S. circuits for Division 1 when connected to Model SA2000 as per drawing 12397"
- (8) WARNING: EXPLOSION HAZARD
   DO NOT DISCONNECT EQUIPMENT AND ASSOCIATED CONNECTORS UNLESS POWER
   HAS BEEN SWITCHED OFF OR AREA IS KNOWN TO BE NON-HAZARDOUS.
  - 1. SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2, AND MAY IMPAIR INTRINSIC SAFETY.
  - 2. ONLY CHANGE BATTERIES IN AN AREA KNOWN TO BE NON-HAZARDOUS.

## AVERTISSEMENT: RISQUE D'EXPLOSION

– AVANT DÉCONNECTER L'EQUIPMENT ET CONNECTEURS ASSOCIES COUPER LE COURANT OU S'ASSURER QUE L'EMPLACEMENT EST DÉSIGNÉ NON DANGEREUX.
– LA SUBSTITUTION DE COMPOSANTS PEUT RENDRE CE MATÉRIEL INACCEPTABLE POUR LES EMPLACEMENTS DE CLASSE I, DIVISION 2, ET PEUT COMPROMETTRE LA SÉCURITÉ INTRINSÈQUE.

– NE PAS CHANGEZ BATTERIES QUE DANS ENDROITS DÉSIGNÉS NON-HASARD.

#### Class I, Division 1 Model 661 Pressure Sensor for Use with Div. 1 Rated Model SA2000 Transmitter:

- (1) Submittor's name, trademark, or the CSA file number (adjacent the CSA Mark).
- (2) Model designation.
  - (3) Date code / Serial number traceable to month and year of manufacture.
- (4) Maximum working pressure 0-400 BAR
- (5) The term "Single Seal"
- (6) Process Temperature Range  $-40^{\circ}$ C to  $+85^{\circ}$ C.
- (7) The CSA Mark with the C/US Qualifiers.
- (8) The designation: "Intrinsically safe for Class I, Division 1, Groups C & D when connected to Model SA2000 as per drawing 12397"

## **REQUIRED METHOD OF MARKING:**

- The marking shall be permanent, such as a 0.5-mm thick metal nameplate secured by drive pins or screws in bottomed holes, cast, etched, or engraved

OR

- on a CSA Accepted Adhesive type nameplate. (Div 2 applications only)

# **ALTERATIONS**

- (1) Markings as noted above.
- (2) The internal 4 pin wiring harness in the Model 63X internal Motorola modem is RTV Silicone secured at both ends.
- (3) Only the Hoffman series enclosures are used for the Model 63X modem.
- (4) Single Seal certification added for the Model Series SA2000 with approved sensors as an assembly.
- (5) Single Seal certification added for the Model 660 and 661 sensor components.

# FACTORY TESTS

None Required

# **FIELD SERVICE INSTRUCTION:**

This report contains reference to certain construction and engineering documents that have been deemed critical to ensuring continued compliance with applicable construction and performance requirements. A list of these documents, with drawing numbers and the appropriate revision levels is summarized in this report. Documents detailed herein are subject to inspection by CSA International personnel and shall be made available in the manufacturing location upon request. Failure to produce these documents in a timely manner constitutes noncompliance and is subject to the actions outlined in the CSA Product Service Agreement.

## **DESCRIPTION**

## Part A: SA100, SA 1.X ORBCOMM, SA200, SA 1.X CDPD Series, Class I, Division 1, Groups C and D:

#### Refer to Illustrations 1 to 18 and Figures 1 to 6.

The subject model is a well site data logger with cellular / satellite communication capability. It is powered by an internal battery pack of Lithium and gel lead acid design with a recharging capability from the solar panel.

#### MICRO SDS TRANSMITTER:

- Instrument Enclosure: Metal, explosion proof. Manufacturer: Adalet-PLM Scott Fetzer Co Cat. No.: XIHS series c/w sight glass cover. Specification: CSA Certified\*, UL Classified For use in Class I, Groups B, C & D, Class II, Groups E, F & G, Class III Type 4
- <u>Main Enclosure</u>: Metal, explosion proof. Manufacturer: Adalet-PLM Scott Fetzer Co Cat. No.: XIF series. Specification: CSA Certified\*, UL Classified For use in Class I, Groups C & D, Class II, Groups E, F & G
- 3. <u>Threaded Nipple: 1/2"</u>: 4 provided as part of 8 and 11 below
- <u>Threaded Reducer: 3/4"-1/2"</u>: 1 provided Manufacturer: Crouse Hinds Cat. No.: RE21 Specification: CSA Certified\*, UL Listed For use in Class I, Groups A, B, C & D, Class II, Groups E, F & G, Class III

<u>Alternate</u>: Any manufacturer and P/N that is CSA Certified\* and UL Listed for use in Class I, Groups C & D.

 <u>Threaded Entry Plugs: 3/4"</u>: 1 provided on Instrument Housing Manufacturer: Crouse Hinds Cat. No.: PLG2 Specification: CSA Certified\*, UL Listed For use in Class I, Groups A, B, C & D, Class II, Groups E, F & G, Class III

<u>Alternate</u>: Any manufacturer and P/N that is CSA Certified\* and UL Listed for use in Class I, Groups C & D.

 <u>Conduit Sealing Fittings: 1/2"</u>: 3 provided Manufacturer: Crouse-Hinds Cat. No.: EYS11 Specification: CSA Certified\*, UL Listed For use in Class I, Groups A, B, C & D, Class II, Groups E, F & G, Class III Sealing Compound: Crouse Hinds Chico A

<u>Alternate</u>: Any manufacturer and P/N that is CSA Certified\* and UL Listed for use in Class I, Groups C & D.

 <u>Conduit Sealing Fittings: 1</u>": 1 provided Manufacturer: Crouse Hinds Cat. No.: EYS31 Specification: CSA Certified\*, UL Listed For use in Class I, Groups A, B, C & D, Class II, Groups E, F & G, Class III Sealing Compound: Crouse Hinds Chico A

> <u>Alternate</u>: Manufacturer: zed.i solutions Cat. No.: See Illustration 11. Specification: Tested for use in Class I, Groups C & D. Sealing Compound: Crouse Hinds Chico A

 <u>Cable Glands: 1/2"</u>: 3 provided Manufacturer: Crouse Hinds Cat. No.: CGB Specification: CSA Certified\*, UL Listed for Wet Locations

<u>Alternate</u>: Any manufacturer and P/N that is CSA Certified\* and UL Listed for use in wet locations.

9. <u>90 deg Elbow</u>:1/2": 1 provided Manufacturer: Crouse Hinds Cat. No.: EL195 Specification: CSA Certified\*, UL Listed For use in Class I, Groups A, B, C & D, Class II, Groups E, F & G, Class III

<u>Alternate</u>: Any manufacturer and P/N that is CSA Certified\* and UL Listed for use in Class I, Groups C & D.

10. <u>Pressure Sensor Assembly</u>:

Manufacturer: ITT Barton

Cat. No.: PC11-XXXXX or CS30-XXXXX per attached table. Specification: Class I, Div. 1, Groups B, C and D previously tested and accepted in ITT Barton CSA NRTL/C test report LR 21338-104. Further evaluated for a continuous working pressure of 500, 1000, 1500, 2000, 2500 or 3000 psi.

<u>Alternate</u>: Optional, replaces above assembly. Manufacturer: zed.i. solutions Cat. No.: See Illustration 12. Specification: Class I, Division 1, Groups C and D (See Tests) Assembly, sleeve, housing and sensor core drawings per Ills 12-16 attached. Pressure core is manufactured by Keller AG, Series PA-8 rated 10-1000 Bar (145-14503 PSI) - tested and qualified only up to 10,000 PSI (689 Bar). Sensor Fitting Sealing Compound: Crouse Hinds Chico A

- Sealed Lead Acid Battery: Located in main X-proof housing. Manufacturer: Panasonic Cat No.: LC-SD122
   Specification: 12 V dc, 4 Ah, UL Recognized
- 12. <u>Lithium Battery</u>: Located in instrument x-proof enclosure.

Manufacturer: Electrochem Cat No.: 3B70, 3B30 or 3B3700 Specifications: 3.9 Voc - 7.0 / 7.0 / 6.2 A.hr

- 13. <u>Interface Board</u>:
  - Glass epoxy measuring approx. 153mm by 85mm by 1.6mm thick - Mounted in main x-proof enclosure on standoffs.

14. <u>OEM Modem Board</u>: Model SA100: Satellite Modem Manufacturer: Magellan Corporation Cat No.: Satellite Modem Specification: Input 12 V dc; RF output 138 - 150 MHz; 5 W Model SA200: Cellular Modem Manufacturer: Sierra Wireless Cat No.: SB300 Specification: Input 5 V dc; RF output 138 - 150 Mhz, 600 mW

15. <u>I.S. Limiting Resistors:</u>

<b>Circuit Designation</b>	Part Number	Manufacturer	Туре	<b>Rated Power</b>	Rated Resistance (Ω)
RS232 Limiting Resistors R13 - R20 Schematic III. 17	D25CRCW1206	VISHAY (Panasonic)	Metal Film	1/4 W	100
RTD Limiting Resistors R2, R3, R6, R7, R9, R13, R14, R16 Schematic III. 8	D25CRCW1206	VISHAY (Panasonic)	Metal Film	1/4 W	75 (2 in series to = 150 effective per line)

 <u>RF DC Blocking Capacitors</u>: Located in series with RF output, 4 provided. Manufacturer: Inmet Corp.

Cat No.: 8055

Specification; DC block, 0.01-18 Ghz, 0.5 dB; inherently limits RF output power to 4 W maximum.

<u>Alternate</u>: Located in series with RF output, 2 provided. Manufacturer: Advanced Technical Materials (ATM) Cat No.: B220-900/900 Specification; DC block, 0.1-2.5 Ghz, 0.5 dB; inherently limits RF output power to 4 W maximum.

<u>Alternate</u>: Located in series with RF output, 2 provided. Manufacturer: Inmet Corp. Cat No.: 8529A Specification; DC block, 0.1-4 Ghz, 0.5 dB; inherently limits RF output power to 4 W maximum.

 17. <u>DC Blocking Diodes</u>: (D2, D3, D12, D13) Manufacturer: General Semiconductor or equivalent Type: 1N5820 Specification: 20 V dc, 3.0 A

#### 18. <u>Control Board</u>:

- Glass epoxy measuring approx. 100mm by 52mm by 1.6mm thick
- Mounted in instrument x-proof enclosure on standoffs.

## SOLAR PANEL ASSEMBLY: Model 522

19. <u>Solar Panel</u>:

Manufacturer: Siemens Cat No.: ST5 Specifications: UL Classified, FM Approved for Class 1, Division 2, Groups A-D; evaluated in this application as a power source with connections in a Class I, Division 1, Groups C & D area. Panel is maximum rated 15.6 V @ 0.32 A, 21.0 Voc, 0.37 A Isc, 5 W max.

<u>Alternate #1</u>: Manufacturer: BP Solar Cat No.: SX 5 Specifications: FM Approved for Class 1, Division 2, Groups C&D; evaluated in this application as a power source with connections in a Class I, Division 1, Groups C & D area. Panel is maximum rated 16.5 V @ 0.27 A, 20.5 Voc, 0.30 A Isc, 4.5 W max.

<u>Alternate #2</u>: Manufacturer: SunWize Technologies Cat No.: OEM 5 Specifications: CSA Certified, FM Approved for Class 1, Division 2, Groups A-D; evaluated in this application as a power source with connections in a Class I, Division 1, Groups C & D area. Panel is maximum rated 16.4 V @ 0.31 A, 20.5 Voc, 0.38 A Isc, 5 W max.

 <u>Battery Voltage Regulator</u>: Manufacturer: Morningstar Corp. Cat No.: SunGuard Specification: Solar Input: 30 V, 4.5 A; Battery Output: 12 V dc, 4.5 A.

**<u>ANTENNA</u>**: (designated Model 65X for PART B or PART D where the "X" in the model designation represents one of the following)

21. <u>Antenna</u>: (Satellite) Model 550 Manufacturer: Alta-Comm Wireless Inc. Cat No.: AC151W with AC318S magnetic base Specification: 136-174 MHz

<u>Alternate</u>: Any manufacturer and part number of passive antenna with maximum electrical characteristics of nominal impedance  $Z = 50 \Omega$ , Maximum C =4.49 µF, L = Maximum 400mH.

22. <u>Antenna</u>: (Cellular) Model 551 Manufacturer: MAXRAD Inc. Cat No.: MUF8005 Specification: 806-866 MHz.

<u>Alternate</u>: Any manufacturer and part number of passive antenna with maximum electrical characteristics of nominal impedance  $Z = 50 \Omega$ , Maximum  $C = 4.49 \mu$ F, L = Maximum 400mH.

22a. <u>RF Patch Cables</u>: (Optional) RG58 RF coaxial cable maximum 5m in length with RG58, N-Male or N-Female or TNC type connectors.

**<u>RTD ASSEMBLY</u>**: Model 552 (designated Model 61X, for PART B or PART C, where the "X" in the model designation represents probe length)

 23. <u>Cable Gland: 1/2"</u>: 1 Provided Manufacturer: Crouse Hinds Cat. No.: CGB Specification: CSA Certified\*, UL Listed for Wet Locations

<u>Alternate</u>: Any manufacturer and P/N that is CSA Certified\* and UL Listed for use in wet locations.

24. <u>4W RTD Device</u>: Passive resistive RTD only. Manufacturer: MINCO Cat No.: CH359

> <u>Alternate</u>: Same type as above Manufacturer: Metalogic Cat No.: MO1-R2D3.5SG series Specification: Stainless steel insertion sheath, with ceramic terminal block.

<u>Alternate:</u> Same type as above Manufacturer: Any manufacturer and P/N that builds an RTD in accordance with the following guidelines and as per Zedi drawings MD12478, MD12477, MD12765, MD12766 and MD12767.

**RTD properties:** 4-wire, Platinum element, Class A DIN EN 60751 (0.00385  $\Omega/\Omega/^{\circ}$ C) 100 Ohm, seamless stainless steel body.

# Part B: Model SA2000 - Class I, Division. 1, Groups C, D

# Refer to Illustrations 19 - 71 and Figures 7 to 10

See the Pressure Sensor Assembly and OPTIONAL RS485 PRESSURE SENSOR sections below for information pertaining to the process seal testing performed under project 205470-2010868. The Model SA2000 can bear the term "Single Seal" when used with the approved Fuji sensor assemblies and the sensor assemblies are used within their respective tested pressure limits. Note the Keller Models 660 & 661 can also bear the term "Single Seal".

The subject model is similar to the SA100 / SA200 series above, Part A, and differs as follows:

#### TRANSMITTER:

 Instrument Enclosure: Metal, double ended, explosion proof. Manufacturer: Adalet-PLM Scott Fetzer Co Cat. No.: XDH series with sight glass cover on one end. Specification: cUL, UL Listed For use in Class I, Groups B, C & D, Class II, Groups E, F & G, Class III Type 4

- 2. <u>Main Enclosure</u>: Not used.
- 3. <u>Threaded Nipple: 1/2"</u>: Not used.
- 4. <u>Threaded Reducer: 3/4"-1/2"</u>: Not used.</u>
- 5. <u>Threaded Entry Plugs: 3/4"</u>: Not used.
- <u>Conduit Sealing Fittings: 3/4"</u>: 2 provided; one for RF / Solar power, the other I/O RTD cabling. Manufacturer: Zed i. Solutions
   Cat. No.: 11610 and 11611, See Illustrations 19 - 22.
   Specification: CSA Tested For use in Class I, Groups B, C & D, Class II, Groups E, F & G, Class III Sealing Compound: Crouse Hinds Chico Type A or Appleton Kwiko Type AC

<u>Alternate Conduit Seal Fitting: 3/4"</u>: Replaces 1 of the above in place of the RF / Solar power fitting, used for RS232 / Solar power interface to Model 63X external modem (see Part D below). Same as above (see Note 4 on Illustration 84) only difference is part is anodized red for identification.

 Pressure Core Coupling Fitting: 1": 1 provided for DPE pressure core connection. Manufacturer: Zed i. Solutions Cat. No.: 11665, See Illustration 23. Specification: CSA Tested For use in Class I, Groups B, C & D, Class II, Groups E, F & G, Class III

> <u>Alternate Pressure Core Coupling Fitting: 1"</u>: 1 provided for Alternate 3 Way Manifold / Fuji pressure core connection. Manufacturer: Zed i. Solutions Cat. No.: 12926 or 12928, See Illustration 73. Specification: CSA Tested For use in Class I, Groups C & D.

- 8. <u>Cable Glands: 1/2"</u>:Not used.
- 9. <u>90 deg Elbow: 1/2"</u>: Not used.
- 10. <u>Pressure Sensor Assembly</u>: Same as Part A above.

<u>Alternate Pressure Sensor Assembly:</u> Comprised of Alternate coupling (Item 7 above), locking ring (See III. 74), 3 way manifold per III. 72 and pressure cores below. The complete assembly has been evaluated / tested for Class I, Division 1, Groups C & D compliance.

Pressures Cores:

Manufacturer:	Fuji Electric
Cat. No.:	FZPX series per Illustration 75 including specific P/Ns FZPXFKC4-B020, FZPXFKG4-
	C020 & FZPXFKG4-C030 (lower pressure versions) – same spec. as below.
Specification:	Class I, Division 1, Groups C and D previously tested and accepted in Fuji Electric CSA
-	test report 172478-1126110 (on file at CSA) rated 50 MPa maximum.

Representative samples of the Fuji sensor models as described in the Fuji drawings TK4G8789C1, TK4G8789C3, TK4G8790C2, TK4G8790C1, TK4G8790C3, and TK4G8789C2 were tested to the process seal requirements of ANSI/ISA 12.27.01-2003. The SA2000 assembly can therefore bear the term "Single Seal" when using any of the tested sensor modules.

 Sealed Lead Acid Battery: Located in X-proof housing, utilizes power supply circuit SC11538. Manufacturer: EXCEL Battery Company or Cantec Inc. Cat No.: 2EXL4138 or 0810-0106T2-L20/3 marked zed.i solutions P/N 11740. Specification: 6 V dc, 2.5 Ah.

> <u>Alternate</u>: Located in X-proof housing, utilizes power supply circuit SC12347. Manufacturer: EXCEL Battery Company or Cantec Inc. Cat No.: 2EXL4157 or 0810-0106-1-L20/3 marked zed.i solutions P/N 12345. Specification: 8 V dc, 2.5 Ah.

- 12. <u>Lithium Battery</u>: Located in instrument x-proof enclosure. Manufacturer: Panasonic or Sanyo Cat No.: BR1216 or CR1220 Specifications: 3.0 Vdc button cell.
- 13. <u>Wiring, Analogue, Power Supply, Processor/Display Boards</u>:
   Glass epoxy measuring approx. 87mm diameter by 1.6mm thick
   Mounted in x-proof enclosure on standoffs.
- 13a. <u>RF Modem/ Solar Panel power, interface board</u>: See Illustrations 24-31.
  - Glass epoxy measuring approx. 112mm by 81mm by 1.6mm thick
  - Mounted in x-proof enclosure on standoffs.

Alternate #1: See Illustrations 53-59.

- Glass epoxy measuring approx. 140mm by 149mm by 1.6mm thick
- Mounted in x-proof enclosure on standoffs.

Alternate #2: Ass # 13089 - Rev. 01 See Illustrations 102 to104

- Glass epoxy measuring approx. 112mm by 81mm by 1.6mm thick
- Mounted in x-proof enclosure on standoffs.
- \* The IS protective features of items 16 & 17 below, remain unchanged.

Alternate #3: Ass # 13089 - Rev. 02 See Illustrations 105 to 107

- Glass epoxy measuring approx. 112mm by 81mm by 1.6mm thick
- Mounted in x-proof enclosure on standoffs.
- \* The IS protective features of items 16 & 17 below, remain unchanged.

Alternate #4: Ass # 14514 – Rev 03 See Illustrations 115 to 117

- Glass epoxy measuring approx. 112mm by 81mm by 1.6mm thick

- Mounted in x-proof enclosure on standoffs.
- \* The IS protective features of items 16 & 17 below, remain unchanged
- 14. <u>OEM Modem</u>: Cellular Modem Manufacturer: Various Cat No.: Various Specification: Input 3.6 to 12 V dc; RF output 100 – 900 MHz, 4W maximum (output dc blocked by C13, C14 below).

<u>Alternates</u>: To be used with Alternate, RF / Solar / Modem Boards, #2 or #3 in item 13a above: Manufacturer & Cat No.: Manufacturer: 'Kyocera', Cat No. Type 200 or Manufacturer: 'AnyDATA', Cat No. Types DT 2000, DTG450 or DTGS450. Specification: Input 4.0 V dc; RF output 800 - 2000 MHz, All rated 0.5 W maximum (output dc blocked by C13, C14 as described below in item16).

<u>Alternate</u>: To be used with Alternate, RF / Solar / Modem Boards, #4 in item 13a above: Manufacturer: 'Cinterion', Cat No. Type TC63, TC63i Specification: Input 5.5 V dc; RF output 850 - 1900 MHz, rated 2.0 W maximum (output dc blocked by C13, C14 as described below in item 16).

15. <u>I.S. Limiting Resistors:</u> (Wiring Board) - see Illustration 32.

Circuit Designation	Part Number	Manufacturer	Туре	Rated Power	Rated Resistance (Ω)
R1, R7	ERJ-1WYJ123U or RMC1-1k2	RCD, Panasonic or others	Metal Film	1 W	1200
R2, R3, R4	ERJ-1WYJ180U or RMC1-18R	RCD, Panasonic or others	Metal Film	1 W	18
R11, R15, R16	RM25, RMC1-18, ERJ-1WXJ-180U or ERJ-1TYJ180U Series	Cal-Chip Electronics, SEI Electronics or Panasonic (2 types)	Metal Film	1 W	18
R5, R6, R8	ERJ or RMC Series	Cal Chip, RCD, Panasonic or others	Metal Film	1 W	18
R12, R13, R14	ERJ-1WYJ910U or RMC1-910R	RCD, Panasonic or others	Metal Film	1 W	910
R17, R19	SE1 RMC 1 or RM73B3A	SEI Electronics or KOA Speer Electronics	Metal Film	1 W	56

16. <u>RF DC Blocking Capacitors</u>: (C13, C14) Located on RF input / output board - see Illustration 24 Manufacturer: Instec Cat No.: T1206NPO331KWT Specification; 330 pF, 1000 V, DC block, 0.01-18 Ghz, 0.5 dB

> <u>Alternates</u>: Same as above except rated 33 pF Cat No. T1206NPO330KWT or Manufacturer: AVX Cat No.: SQCB7M330JAJME Specification; 33 pF, 500 V, DC block, 10 MHz – 4.2 GHz

- 17. <u>DC Blocking Diodes</u>: (D5, D6 RF Board, D18, D19 Wiring Board) Manufacturer: General Semiconductor or equivalent Type: SS34 Specification: Min 40 V dc, 3.0 A
- 18. <u>Control Board</u>: Not used.

# Alternate Configuration For Use With Fuji DP/GP Cores / External Model 63X Modem Unit

- 13. <u>Alternate Wiring Board For Fuji Cores</u>: See Illustrations 77-79.
  - Glass epoxy measuring approx. 87mm diameter by 1.6mm thick
  - Mounted as above.

# 13a. <u>RF / Solar / Modem Board</u>:

14. <u>OEM Modem</u>: Not used, replaced by RS232 Interface Board See Illustrations 80-82, - Glass epoxy measuring approx. 14cm by 7.7cm by 1.6mm thick

## 15. <u>I.S. Limiting Resistors:</u>

#### Wiring Board - see Illustration 77.

Circuit Designation	Part Number	Manufacturer	Туре	Rated Power	Rated Resistance (Ω)
R5, R6	RM25J122CT or RMC1- 122-5%	Cal Chip, SEI or others	Metal Film	1 W	1200
R1-4, R9-16, R18, R20, R21	RM25J180CT or ERJ- 1WYJ180U or ERJ- 1TYJ180U or RMC1- 18R-5%	Cal Chip, SEI, Panasonic or others	Metal Film	1 W	18
R7, R8, R17	MC2512-910R-JT, ERJ- 1WYJ911U or RMC1- 910R or RM25J911CT	RCD, Panasonic, SEI, Cal Chip or others	Metal Film	1 W	910

# **RS232 Interface Board -** see Illustration 80.

Circuit Designation	Part Number	Manufacturer	Туре	Rated Power	Rated Resistance (Ω)
R14—16, R20-22, R39- 46	ERJ-8GEYJ101V or CRCW1206 101JRT1	Panasonic or Vishay	Metal Film	1/8 W	100
R28	ERG2SJ101 or 5083NW100ROJ12AFX	Panasonic or BC Components	Metal Film	2 W	100
R35, R36	CRCW1206 1003JRT1	Vishay or others	Metal Film	1/8 W	100k
R12, R13, R18, R19	MC2512-910R-JT, ERJ- 1WYJ911U or RMC1- 910R or RM25J911CT	RCD, Panasonic, SEI, Cal Chip or others	Metal Film	1 W	910

- 15a <u>Protective Fuse</u>: (F2) Limits available fault current through limiting resistor R28 Certified, UL Recognized `Littelfuse' P/N 43301 rated 24 V, 1 A.
- 16. <u>RF DC Blocking Capacitors</u>: Not Used.
- 17. <u>DC Blocking Diodes</u>: (D19, D20 RS 232 Interface Board) Manufacturer: General Semiconductor or equivalent Type: SS34 Specification: Min 40 V dc, 3.0 A
- 18. <u>Control Board</u>: Not used.

#### SOLAR PANEL ASSEMBLY: Model 620

19. <u>Solar Panel</u>:

Manufacturer: BP Solar Cat No.: SX 5 Specifications: FM Approved for Class 1, Div. 2, Groups C&D; evaluated in this application as a power source with connections in a Class I, Div. 1, Groups C & D area. Panel is maximum rated 16.5 V @ 0.27 A, 20.5 Voc, 0.30 A Isc, 4.5 W max.

<u>Alternate #1</u>: Manufacturer: SunWize Technologies Cat No.: OEM 5 Specifications: CSA Certified, FM Approved for Class 1, Div. 2, Groups A-D; evaluated in this application as a power source with connections in a Class I, Div. 1, Groups C & D area. Panel is maximum rated 16.4 V @ 0.31 A, 20.5 Voc, 0.38 A Isc, 5 W max.

<u>Alternate #2</u>: Manufacturer: Shell Solar Cat No.: ST5 Specifications: FM Approved for Class 1, Div. 2, Groups A-D, T5; evaluated in this application as a power source with connections in a Class I, Div. 1, Groups C & D area. Panel is maximum rated 15.6 V @ 0.32 A, 22.9 Voc, 0.39 A Isc, 5 W max.

<u>Alternate #3</u>: Manufacturer: Star Power Intl. Ltd. Cat No.: CTI-05 Specifications: Evaluated in this application as a power source with connections in a Class I, Division 1, Groups C and D area. Panel is maximum rated 16.5V @ 0.27A, 20.5Voc, 0.30A Isc, 5W max.

<u>Alternate #4:</u> Manufacturer: Yuhuan Sinosola Co.,Ltd. Cat No.: GP5-36 Specifications: Evaluated in this application as a power source with connections in a Class I, Division 1, Groups C and D area. Panel is maximum rated 17.8V @ 0.28A, 21.3Voc, 0.30A Isc, 5W max.

<u>Alternate #5:</u> Manufacturer: BP Solar Model: SX-305M Specifications: Evaluated in this application as a power source with connections in a Class I, Division 1, Groups C and D area. Panel is maximum rated 16.5V @ 0.27A, 20.5Voc, 0.30A Isc, 4.5W max.

<u>Alternate #6:</u> Manufacturer: Innergy Power Corporation Model: IP5F Specifications: Evaluated in this application as a power source with connections in a Class I, Division 1, Groups C and D area. Panel is maximum rated 16.8V @ 0.27A, 19.8Voc, 0.31A Isc, 4.53W max.

Alternate #7:

Manufacturer: Kyocera Model: KS5 Specifications: Evaluated in this application as a power source with connections in a Class I, Division 1, Groups C and D area. Panel is maximum rated 16.9V @ 0.29A, 21.5Voc, 0.31A Isc, 5W max.

19a <u>Bias Tee / Surge Arrestor</u>: See Illustration 91

`NexTek, Inc.', Type BTL-C04, Installed on solar panel rated Division 2, in RF and Power lines as shown.

<u>Alternate Bias Tee / Surge Arrestor</u>: See Illustration 108 `NexTek, Inc.', Type BTL-C05, Installed on solar panel rated Division 2, in RF and Power lines as shown.

#### SOLAR PANEL ASSEMBLY: Model 621 - same as above, except:

- 1. <u>Manufacturer</u>: BP Solar
  - Cat No.: SA-5 LV

Specifications: FM Approved for Class 1, Division 2, Groups C & D; evaluated in this application as a power source with connections out to a Class I, Division 1, Groups C & D area. Panel is maximum rated 21.9 Voc, 0.44 A Isc, 5 W max.

Optional Construction

May optionally be constructed with an in-line resistor  $(2.2 - 2.7\Omega, 5\%, 2W)$  installed in the solar panel cable per drawing 15005 (Illustration 118).

<u>Bias Tee / Surge Arrestor</u>: See Illustrations 111 & 112
 `zed. i. solutions', Part No. 14449, rated and tested as Type 4 compliant; installed on solar panel rated Div. 2, in RF and Power lines as shown.

a) Enclosure: Certified and/or UL Listed Type 4 enclosures `Hammond', Type CO2175M.

- b) <u>N.I. Power Connector</u>: (A1) Accepted, 'Switchcraft', EN3 series panel mount connector, tested for Type 4 compliance.
- c) <u>N.I. TNC Connector</u>: (J1) Accepted, `Lighthorse Technologies', CB4-CTSASG-TF3NT series panel mount connector, tested for Type 4 compliance.
- d) <u>N.I. N Connector</u>: (J2) Accepted, 'Lighthorse Technologies', CB4-CTSASG-NF3NT series panel mount connector, tested for Type 4 compliance.

## **SOLAR PANEL ASSEMBLY: Model 622** - same as 621 above, except:

1. <u>Manufacturer</u>: BP Solar

Cat No.: SA-5

Specifications: FM Approved for Class 1, Division 2, Groups C & D; evaluated in this application as a power source with connections out to a Class I, Division 1, Groups C & D area. Panel is maximum rated 24.8 Voc, 0.41 A Isc, 5 W max. IS output is limited to 24.8 Voc, 0.396 A Isc by an in-line 2.2-2.7 ohm / 5% / 2 W resistor at the solar panel as shown in Illustrations 113 or 114 to obtain the required 1.5 safety factor for IS circuits in a Division 1 area.

10 W (2 X 5W) Panel Option: Comprised of the following components, see Illustration 66:

## 2 Model 620 Panels <u>OR</u> 2 Model 621 Panels + 641 Barrier

- 1. <u>Solar Panels</u>: 2 Model 620 <u>or</u> 621 panels as described above.
- 2. <u>Non-Incendive / IS Barrier Assembly</u>: Model 641. See Illustrations 66, 109 & 110.

a) Enclosure: Any of the following metal, Certified and/or UL Listed Type 4 enclosures may be used.

Manufacturer	Model / Part Number
Bud Industries	AN-1303 or AN-1303-G
A.B. Controls & Technology Ltd.	ZAG 5R
Hoffman	C-CA886
Bel Products	S040403AL

- b) <u>Solar Panel N.I. Input Connectors</u>: (CON1, CON2) Accepted, 'Switchcraft', EN3 series panel mount connector, previously tested for Type 4 compliance.
- c) <u>I.S. Output Cable Gland:</u> (CON3) UL Recognized, Certified liquid tight glands 'Hummel', Type HSK-K, or 'Lapp Canada', Type S2207 / S2107 or 'Heyco', Type 3207.
- d) <u>Non-Incendive Protection Diodes</u>: Schottky type 1N5821 or 1N5822 rated min 30 V, 3 A. Provides non-incendive isolation of each input 5 W panel circuit.
- e) <u>I.S. Limiting Resistor</u>: 'Yageo Corporation', type SQP10AJB-22R ceramic cement encased type or 'Ohmite Mfg.', type 20J22R enameled wire wound type both rated 22 ohm, 10 W; epoxy secured to the enclosure base. Limits combined solar panel output Isc to acceptable levels.

ANTENNA: Models 65X- same as above in Part A.

**<u>RTD ASSEMBLY</u>**: Model 61X - same as above in Part A except probe sheath may be 2.5cm to 30cm in length.

**OPTIONAL RS485 PRESSURE SENSOR: Model 660** - 1 or 2 provided per installation drawing, see Illustrations 67-71 for 200 & 400 Bar MWP versions. See Illustration 89 for low pressure (1-10 Bar) option.

Manufacturer: Keller A.G. Cat. No.: Series 33, 35 or 36 Digitally Compensated Pressure Transmitter (Differs only in pressure range and external connection methods) Specification: LCIE CENELEC type approved for EEx ia IIC T6 to T4, CSA Tested For use in Class I, Division 2, Groups C & D. Ratings: 4-20 mA or 0-10 V, Ci = 0; Li = 0; Ui <30 V; Pi < 1.2 W

Representative samples of the Keller Series 35Ei sensors as described in the Keller drawings 233515.0006 and 233515.0010 were tested to the process seal requirements of ANSI/ISA 12.27.01-2003. As per test plan PDN 285-01 the assembly number 0036 was tested to 400 Bar and is deemed representative of both models. The unit was tested with a temperature rating of -40 to +85°C. The Model 660 Keller sensors can bear the term "Single Seal".

<u>ALTERNATE RS485</u> <u>PRESSURE SENSOR</u>: Model 660 - 1 or 2 provided per installation drawing, see Illustrations 97-100.

Manufacturer: Keller A.G. Cat. No.: Series 33XEI or 35XEI Digitally Compensated Pressure Transmitter – similar to Models 33 / 35 series above, same process sealing provisions, modified electronics and assembly body length. Specification: KEMA ATEX type approved for EEx ia IIC T6 to T4, CSA Tested For use in Class I, Division 2, Groups C & D. Ratings: 4-20 mA or 0-10 V, Ci = 0 (supply & current output) 50 nF (RS485 & voltage output); Li = 0; Ui <30 V; Pi < 1.2 W; Ii < 100 mA.

<u>ALTERNATE RS485 PRESSURE SENSOR:</u> Model 661 – 1 or 2 provided per installation drawing 12397, see Illustrations 66, 97 - 100.

Manufacturer: Keller A.G. Cat. No.: Series 35X Ei Digitally Compensated Pressure Transmitter – similar to Models 35 series above, same process sealing provisions, with modified connectors. Specification: KEMA ATEX type approved for EEx ia IIC T6 to T4, CSA evaluated for use in Class I, Div. 1, Groups C & D. Ratings: 4-20 mA or 0-10 V, Ci = 0 (supply & current output) 50 nF (RS485 & voltage output); Li = 0; Ui <22 V; Pi < 1.2 W; Ii < 200 mA.

Representative samples of the Keller Series 35X Ei sensors as described in the Keller drawings 233515.0036 and 233515.0037 were tested to the process seal requirements of ANSI/ISA 12.27.01-2003. As per test plan PDN 285-01 the assembly number 0036 was tested to 400 Bar and is deemed representative of both models. The unit was tested with a temperature rating of -40 to +85°C. The Model 661 Keller sensors can bear the term "Single Seal".

# Part C: Model SA2000 - Class I, Division 2, Groups C, D

The subject model is identical to the model described in Part B above and differs only in the required markings (see above) and the permitted use of the Certified 'Zed.i. solutions', Model 110 non-incendive battery unit as an alternate external battery source. The additional components used are listed below.

- External Battery Unit: C\_US Certified\* Manufacturer: Zed.i. solutions Cat. No.: 110 Specification: Certified for use in Class I, Division 2, Groups C & D Ratings: 13.8 V dc, 90 Ahr with non-incendive charging output.
- 2. <u>External Battery / RTD Cable</u>: Manufacturer: Zed.i. solutions Part. No.: 12331 Specification: See Ill. 61

<u>Class I, Div. 2 Model 61X RTD ASSEMBLY</u>: Same as above (Part B) except for use only with Class I, Div.2 rated SA2000 and marked as such per MARKINGS.

## Part D: Model 630 External Modem - Class I, Division 2, Groups C, D

Refer to Illustrations 85-88 and Figure 11

The subject model is an external replacement to the internal modem used in the SA2000 series above:

- Enclosure:

   Manufacturer:
   Hoffman

   Cat. No.:
   L-HC353020 or L-HC353020MOD

   Specification:
   Certified, UL Listed, Type 4 rated.
- 2. <u>RF TNC Connector</u>: Accepted, `Citel', P/N P8AX09TNCWFF bulkhead TNC connector, tested for Type 4 compliance.
- 3. <u>Solar Panel Power Connector</u>: Accepted, 'Switchcraft', EN3 series panel mount connector, tested for Type 4 compliance.
- 4. <u>RS232 Cable Gland</u>: Certified, UL Listed `Crouse Hinds', P/N CGB193-SG, rated for wet locations.
- 5. <u>Sealed Lead Acid Battery</u>: Located in type 4 housing.

Manufacturer:EXCEL Battery Company or Cantec Inc.Cat No.:2EXL4157 or 0810-0106-1-L20/3 marked Zed.i solutions P/N 12345.Specification:8 V dc, 2.5 Ah.

6. <u>External Modem I/O Board</u>:

- Glass epoxy measuring approx. 14.6cm by 6.9cm diameter by 1.6mm thick - Mounted in enclosure on standoffs.

7. <u>I.S. Limiting Resistors</u>: - see Illustration 85.

Circuit Designation	Part Number	Manufacturer	Туре	Rated Power	Rated Resistance (Ω)
R1, R2, R6-15,	ERJ-8GEYJ101V or	Panasonic or	Metal	1/8 W	100
R39-46	CRCW1206 101JRT1	Vishay	Film		

- <u>DC Blocking Diodes</u>: (D8, 9, 11, 12, 14, 16 Modem I/O Board) Manufacturer: General Semiconductor or equivalent Type: SS34 Specification: Min 40 V dc, 3.0 A
- 9. <u>OEM Modem</u>: Accepted, 'Motorola Inc.', 9522 Satellite Series, rated 4.4 V dc; average RF output power during maximum transmission slot is <2.5 W. See Illustration 88 for detailed schematics
- 10. <u>SOLAR PANEL ASSEMBLY</u>: Model 620 same as above in Part A except external battery regulator not provided (regulation internal to unit).
- 11. <u>ANTENNA</u>: Models 65X- same as above in Part A.

## Part E: Model 631 External Modem - Class I, Division. 1, Groups C, D

Refer to Illustration 92.

The subject model is identical to the Model 63X described in Part D above with the following enclosure / external wiring details to comply with for Division 1 installation requirements:

- <u>Main Enclosure</u>: Metal, explosion proof. Manufacturer: Adalet-PLM Scott Fetzer Co Cat. No.: XIFC 041204 series. Specification: CSA Certified\*, UL Listed For use in Class I, Groups C & D, Class I, Groups E, F & G, Type 4.
- <u>Conduit Sealing Fittings: 3/4"</u>: 1 provided for SA2000 I/O RTD cabling. Manufacturer: Zed i. Solutions Cat. No.: 11610 and 11611, See Illustrations 19 - 22. Specification: CSA Tested For use in Class I, Groups B, C & D, Class II, Groups E, F & G, Class III Sealing Compound: Crouse Hinds Chico Type A or Appleton Kwiko Type AC
- <u>Threaded Reducer: 1"-34" or 3/4"-1/2"</u>: Optional, 1 May Be Provided Manufacturer: Crouse Hinds Cat. No.: RE series. Specification: CSA Certified\*, UL Listed For use in Class I, Groups A, B, C & D, Class II, Groups E, F & G, Class III

<u>Alternate</u>: Any manufacturer and P/N that is CSA Certified\* and UL Listed for use in Class I, Groups C & D.

4. <u>Conduit Sealing Fittings; 1/2, 3/4 or 1"</u>: 1 provided within 1.5" of item 1. above Manufacturer: Crouse-Hinds Cat. No.: EYS series.
Specification: CSA Certified\*, UL Listed For use in Class I, Groups A, B, C & D, Class II, Groups E, F & G, Class III Sealing Compound: Crouse Hinds Chico A

<u>Alternate</u>: Any manufacturer and P/N that is CSA Certified\* and UL Listed for use in Class I, Groups C & D.

- <u>90 deg Elbow & Nipples; 1/2, 3/4 or 1</u>": As per Illustration 92. Manufacturer: Various Cat. No.: Various Specification: CSA Certified\*, UL Listed For use in Class I, Groups A, B, C & D, Class II, Groups E, F & G, Class III
- 9. <u>Alternate OEM Modem</u>: Model 631 Class 1, Division 1 rated assembly ONLY, similar to above, Accepted, 'Motorola Inc.', 9522-A Satellite Series, rated 4.4 V dc; average RF output power during maximum transmission slot is <2.5 W.

<u>Alternate OEM Modem:</u> Model 631 Class I, Division 1 rated assembly ONLY Accepted, 'Iridium ', 9522B Satellite Series, rated 4.4 V dc; average RF output power during maximum transmission slot is 4 W.

## Part F: Model 690 External Battery - Class I, Div. 2, Groups C, D

Refer to Illustrations 93-96.

The subject model provides additional reserve battery power capacity to the SA2000 as shown in Illustration 66.

- Enclosure:

   Manufacturer:
   Hoffman

   Cat. No.:
   L-HC353020 or L-HC353020MOD

   Specification:
   Certified, UL Listed, Type 4 rated.
- 2. <u>Solar Panel Power Connector</u>: Accepted, 'Switchcraft', EN3 series panel mount connector, tested for Type 4 compliance.
- 3. <u>SA2000 IS Power Cable Gland</u>: Certified, UL Listed `Crouse Hinds', P/N CGB192-SG, rated for wet locations.
- 4. <u>Enclosure Breather</u>: Certified `REDAPT', P/N DP-E-4-0-29-53, rated CSA Type 4X.
- 5. <u>Sealed Lead Acid Battery</u>: Located in type 4 housing. Manufacturer: MK Battery Cat No.: 8A22NF marked zed.i solutions P/N 12943. Specification: 12 V dc, 63 Ah.

Alternate:Manufacturer:Interstate BatteryCat No.:DCS-50 series marked zed.i solutions P/N 12943.Specification:12 V dc, 55 Ah.

Alternate:Manufacturer:Power Sonic BatteryCat No.:PS-12550 marked zed.i solutions P/N 12943.Specification:12 V dc, 55 Ah.

Alternate:Manufacturer:Panasonic BatteryCat No.:LC-LA1233P marked zed.i solutions P/N 12942.Specification:12 V dc, 33 Ah.

Alternate:Manufacturer:Interstate BatteryCat No.:DCS-33 series marked zed.i solutions P/N 12942.Specification:12 V dc, 33 Ah.

Alternate:Manufacturer:Power Sonic BatteryCat No.:PS-12330 marked zed.i solutions P/N 12942.Specification:12 V dc, 35 Ah.

6. <u>Charge Control I/O Board</u>:

- Glass epoxy measuring approximately 13.7cm by 38cm by 1.6mm thick

- Mounted in enclosure on standoffs.
- 7. <u>I.S. Limiting Resistors</u>: see Illustration 94.

Circuit	Part Number	Manufacturer	Туре	Rated	Rated
Designation				Power	Resistance ( $\Omega$ )
R7, R29	SQP10AJB-3R9	Yageo	Ceramic Encased	10 W	3.9 ohm
R7, R29	NSP10 3.9R 5% A	NTE	Ceramic Encased	10 W	3.9 ohm
R7, R29	PW10 3.9R 5%	IRC	Ceramic Encased	10 W	3.9 ohm
R7, R29	SQP10AJB-3R9	RCD (SEI)	Ceramic Encased	10 W	3.9 ohm

 <u>DC Blocking Diodes</u>: (D3, 6, 7 - I/O Board) Manufacturer: General Semiconductor or equivalent Type: SS34 Specification: Min 40 V dc, 3.0 A

# **DESCRIPTIVE DOCUMENTS**

**<u>NOTE</u>**: Documents detailed herein are subject to inspection by CSA International personnel and shall be made available in the manufacturing location upon request.

# **List of Figures:**

<b>Figure No.:</b>	Description:
1	Transmitter Overall View
2	Antenna
3	Internal view RTD
4	Overall view RTD
5	DC Blocking Capacitors
6	Grounding of DC Blocking Capacitors
7, 8	Control Wiring Boards Of SA2000 Transmitter
9	RF Section Boards / Battery Of SA2000 Transmitter
10	Overall View Of SA2000 Transmitter
11	Internal View Of Model 63X Internal Motorola Modem
12	Bill of Material for SA2000 Smart-Alek - BM12611-16_13090-92_13179-1_14430_14432_
	14561-3_15203-06 SA V2 FI Top Level ASM 2008-10-23 (2 Pages)
13	Bill of Material for Model 660 Keller sensor - BM12750-52_14511-13_12497-8_12638-9_14440-
	41_
	12640-41_15661 Keller RS-485 Pressure Sensor Assembly 2007-09-24 (2 Pages)
14	Bill of Material for Model 661 Keller sensor -
	BM13798_13799_13800_13801_13793_13794_15961_
	15962_13796_13797_15969_15970 V2X C1D1 Keller Sensor Assy 2008-10-09 (2 Pages)

# **List of Illustrations:**

Illus No.	Drawing No.	Description
1	12618_R4	Label Drawing, SA2000
2	-	Label Drawing, Model 551 & 552
3	-	Label Drawing, Model 552
4	DELETED	* IS Resistors Moved to Board **
5	ZSD2.500.20.SCH	RTD/Controller Schematics (7 pages)
6		RTD/Controller CCT Board Drawings (10 pages)
7		Solar Panel Assembly Drawings
8	ZSD2.500.22.SCH	IS Interface Schematic
9		IS Interface CCT Board Drawings (6 pages)
10	ZSD2.502.B01	Top Level Assembly Drawing
11	ZSD2.500.09A03	Optional 1" Conduit Seal Drawing
12	ZSD2.500.13A02	Optional 1" Pressure Sensor Assembly Drawing
13	ZDS2.500.03A02	Optional 1" Pressure Sensor Sleeve Drawing
14	ZSD2.500.05B04	Optional 1" Pressure Sensor Seal Housing Drawing
15	ZSD2.500.14.01A01	Optional 1" Pressure Sensor Pressure Core Housing (NPT)
16	ZSD2.500.15A02	Optional 1" Pressure Sensor Pressure Core Housing (Autoclave)
17	ZSD2-500.23.SCH	Modem Interface Schematic
18		Modem Interface CCT Board Drawings (4 pages)
19 / 20	11609 / 11610	RF Cable Assembly / Conduit Seal Drawings
21/22	11660 / 11611	I/O Cable Assembly / Conduit Seal Drawings
23	11665	DPE Core Mounting Coupling
24	SC11541	RF Modem / Solar Power Input Schematic
25 - 29	PC 11541	RF Modem / Solar Power Input Printed Board Layouts
30, 31	B.O.M.	Modem Board Bill Of Materials
32	SC11540	IS Wiring Board Schematic
33 - 39	PC 11540	IS Wiring Board Printed Board Layouts
40, 41	B.O.M.	IS Wiring Board Bill Of Materials
42 - 44	SC11538	Power Supply Schematics
45 - 47	SC11539	Analogue Schematics
48 - 52	SC11537	Processor Schematics
53	SC11536	Display Schematics
54 - 55	SC11256	Alternate RF Modem / Solar Power Input Schematic
56 - 60	PC 12156	Alternate RF Modem / Solar Power Input Printed Board Layouts
61	SC12302	CSC Modem Daughter Board
62-64	SC12347	Power Supply Schematics For Alternate 8 V Internal Battery
65	12331	Assembly Drawing For Class I, Div.2 SA2000 External Battery
		Power / RTD Cable
66	12397 (Rev. 12 - 13 Pages)	Installation Drawing for Div 1. and Div 2. Applications
		Including Entity Parameters.
67	01.E6011 X (2 Pages)	LCIE Certificate For Keller 3X Probes
68	8087X (4 Pages)	Keller 3X Probes Mechanical Drawings
69	9I070-X (6 Pages)	Keller 3X Probe Transmitter Schematics, PCB Layouts &
		B.O.M.
70	9U024-X (4 Pages)	Keller 3X Probe I.S. Protection Schematics, PCB Layouts &
		B.O.M.
71	Various (8 Pages)	Keller 3X 200-400 BAR Pressure Diaphragm Mechanical
		Drawings

72	12606 – Rev. 4A (2 Pages)	DP/GP Core 3 Way Manifold Machining & Casting Detail	
73	12926 & 12928 – Rev. 1 (2	3 Way Manifold Transition Coupler to SA2000 Housing (2	
	Pages)	Versions)	
74	12608 – Rev. 2 (1 Pages)	3 Way Manifold Transition Locking Ring	
75	TD533360 – Rev. b (6 Pages)	Fuji Electric DP / GP Core Specifications	
76	TC425311 – Rev. a (2 Pages)	Fuji Electric DP / GP Core Drawings	
77	SC12294 – Rev. 02 (1 Page)	Alternate Interface Wiring Board Schematic For Fuji Electric	
		GP/DP Sensors	
78	PC12294 – Rev. 02 (8 Pages)	Alternate Interface Wiring Board Layouts For Fuji Electric	
		GP/DP Sensors	
79	BM 12295 – Rev. 02A (2 Pages)	Alternate Interface Wiring Board Bill Of Materials	
80	SC12462 – Rev. 04 (2 Pages)	RS232 Interface Wiring Board Schematics	
81	PC12462 – Rev. 04 (4 Pages)	RS232 Interface Wiring Board Layouts	
82	BM12461 – Rev. 04b (1 Page)	RS232 Interface Wiring Board Bill Of Materials	
83	12578 – Rev. 2 (1 Page)	RS232 Internal Cable & Conduit Seal Detail	
84	12644 – Rev. 01 (1 Page)	Conduit Seal (Same as 11611 except anodized red for	
		identification)	
85	SC12464 – Rev. 02A (4 Pages)	External Modem I/O Board Schematics	
86	PC12464 – Rev. 02 (7 Pages)	External Modem I/O Board Layouts	
87	BM12463 – Rev. 02E (2 Pages)	External Modem I/O Board Bill Of Materials	
88	Various (14 Pages)	Motorola Series 9522 Series Modem Schematics	
89	Various (5 Pages)	Keller 1 -10 Bar Probes Mechanical Drawings	
90	1 Page – Rev. 01	10 W Solar Barrier Model 640 Schematic	
91	730-0016 - Rev. 00	Model 620 Surge Arrestor Specification / Schematic	
92	Assm schedule, Rev. 0	Model 631 Div. 1 Modem Assembly Drawing	
93	L-HC353020, Rev. 0 (2 Pages)	Model 690 Div. 2 External Battery Enclosure Assembly	
		Drawings	
94	12772, Rev. 03, (2 Pages)	Model 690 Schematics	
95	PC12772, Rev. 03 (3 Pages)	Model 690 PC Board Layouts	
96	BM12874, Rev. 03	Model 690 PC Board Bill Of Materials	
97	04ATEX1081X (3 Pages)	KEMA ATEX EX ia Certificate For Keller 35XEI Probe	
98	81876.32 (1 Pages)	Keller 35XEI Probes Mechanical Drawing	
99	9I106-X (6 Pages)	Keller 3X Probe Transmitter Schematics, PCB Layouts &	
		B.O.M.	
100	9U054-X (4 Pages)	Keller 3X Probe I.S. Protection Schematics, PCB Layouts &	
		B.O.M.	
101	81870.12 (1 Pages)	Keller 33XEI Probes Mechanical Drawing	
102	SC13089 – Rev. 01 (3 Pages)	Modem I/O Board Schematics	
103	PC13089 – Rev. 01 (6 Pages)	Modem I/O Board Layouts	
104	BM13127 – Rev. 01 (1 Page)	Modem I/O Board Bill Of Materials	
105	SC13089 – Rev. 02 (3 Pages)	Modem I/O Board Schematics	
106	PC13089 – Rev. 02 (6 Pages)	Modem I/O Board Layouts	
107	BM13127 – Rev. 02 (1 Page)	Modem I/O Board Bill Of Materials	
108	730-0018 - Rev. E1	Model 620 Alternate Surge Arrestor Specification / Schematic	
109	13993 – Rev. 1.0	10 W Solar Barrier Model 641 Schematic	
110	BM 12924 – Rev. 04B / BM	10 W Solar Barrier Model 640 & 641 Bill Of Materials	
	13993 – Rev. 02		
111	BIAS-T – Rev. 1V2	Alternate Bias T Schematic	
112	BIAS-T BOM – Rev. 1V2	Alternate Bias T Bill Of Materials	
113	14458 – Rev 4	Solar Panel Model 622 Assembly (with IS Resistor Mod) Option	

		1
114	14874 – Rev. 2	Solar Panel Model 622 Assembly (with IS Resistor Mod) Option
		2
115	SC14514 – Rev. 03 (2 Pages)	Modem I/O Board Schematics
116	PC14514 – Rev. 03 (6 Pages)	Modem I/O Board Layouts
117	BM14515 & BM14516 -	Modem I/O Board Bill of Materials
	Rev. 01 (1 Page)	
118	15005 – Rev 01 (1 Page)	Solar Panel Model 621 SA-5LV Assembly Option 1
119	MD12478	6in 100 ohm platinum RTD 20 ft model 612
120	MD12477	6in 100 ohm platinum RTD 10 ft model 612
121	MD12765	RTD 3m cable w overmold model 612
122	MD12766	RTD 6m cable w overmold model 612
123	MD12767	RTD 10m cable w overmold model 612

# TEST RESULTS

#### **Project 1153379, Edition 1**:

Part A: SA100 / 200 Series with RTD, Solar Panel, Antenna

## **GENERAL**

#### Temperature

Tested with lead acid battery discharged and simulated solar panel input for recharging at max current 0.37 A.

Thermocouple Locations	Max Deg C
Diode D1	28
Diode D12	28
Converter U1	26
Diode D3	33
Diode D4	25
Diode D2	25
Resistor R1	29
Lead Acid Battery Case	26
Main X-Proof Housing	25
Instr. X-Proof Housing	25
Ambient	25

## Fluid Seal Tests

The Barton Instruments pressure transmitter was subjected to the tests from Std 30-M1986, Clause 4.10.6.3 and 4.10.6.4 with a working pressure of 3000psi.

4.10.6.3 Test Pressure of 5758psi for 1 minute without leakage

4.10.6.4 Test Pressure of 8516psi for 1 minute without rupture

Results: Satisfactory, there was no leakage or rupture of the devices at the specified pressures.

#### **INTRINSIC SAFETY PROTECTION**

#### **Solar Panel**

The solar panel is rated at 21.0 Voc, and 0.37 A Isc. The maximum safe parameters for use in Group C are 21.0V and 1.004A (1.0 factor) and 0.670A (1.5 factor). The solar panel has a factor of safety of at least 2.7 based on the solar panel output and required current for ignition. Therefore the Solar Panel can be considered as providing an IS source for use in Class I, Groups C and D.

The solar panel regulator does not contain any significant energy storage devices and therefore does not contribute any energy to the IS system.

# **Solar Panel Input**

The Solar Panel is connected to CON1 on the Interface Board. This connector is used for connection of the solar panel as well as for connection to a computer when the entire device is located in an ordinary location.

The solar panel interface board is provided with two diodes (D12 and D3) to prevent any internal voltage from appearing at the connection. A Thermal Fuse (PCT2) is used to limit the current from the Solar Panel going into the main circuitry. Two diodes (D2 and D13) also protect a Vexternal line that is connected to CON1. All other connections are protected by 100 Ohm 1/8W resistors (R13 - R20)

## **RTD Output**

The RTD output is protected by eight 75 Ohm 1/8W resistors (two in series for effective 150 ohm per line) that are pcb board mounted before it exits the explosion proof enclosure assembly.

#### Antenna

DC is blocked from reaching the antenna by means of four blocking capacitors Manufacturer: Inmet Corp., Cat No.: 8055, Specification; DC block, 0.01-18 Ghz, 0.5 dB; which also inherently limits RF output power to 4 W maximum. These capacitors are located in the output cable to the antenna before it exits the explosion proof enclosure assembly. These Capacitors have passed a 500 Vac dielectric test.

## **SPARK IGNITION**

Spark Ignition tests were waived due to the analysis showing a factor of safety of minimum 2.0 for all circuits involved.

# **TEMPERATURE CODE RATING**

Temperature Code ratings are only considered necessary on the accessories of the data logger & transmitter (solar panel, RTD, Antenna)

Solar Panel tests not performed due very little temperature rise on the solar panel due to the inherent nature of a solar panel.

RTD tests not performed due to high internal resistance.

Antenna tests not performed due to DC blocked from reaching the antenna and RF power does not cause significant heating on the antenna.

A temperature test was performed on the solar panel regulator. The solar panel was simulated with a 21Vdc source, electronically current limited to 0.37A and was connected normally. The output of the regulator was then sorted and temperatures were measured on the regulator. The maximum temperature achieved was 40.2°C corrected to a 40°C ambient.

#### **PROTECTIVE RESISTORS**

Calculations show that all protective resistors operate at less than their power rating under normal and fault conditions; therefore no further evaluation was required.

## **PROTECTIVE DIODES**

Calculations show that all protective diodes operate at less than their current rating under normal and fault conditions; therefore no further evaluation was required.

No further testing was deemed necessary.

## Project 1169742, Edition 2:

<u>**GENERAL**</u>: Due to the nature of the alternate components added only the following tests were deemed necessary.

#### Fluid Seal Tests

The alternate PT sensor probe pressure sensor (process side) was subjected to the tests from Std 30-M1986, Clause 4.10.6.3 and 4.10.6.4 with a working pressure of 10,000 psi.

4.10.6.3Test Pressure of 18008psi for 1 minute without leakage 4.10.6.4Test Pressure of 26016psi for 1 minute without rupture.

Results: Satisfactory, there was no leakage or rupture of the devices at the specified pressures.

#### Conduit Seal Tests: zed.i. solutions alternate 1" conduit seal and pressure sensor housing:

Both the 1" conduit seal and pressure sensor housing were subjected to the following tests

C22.2 No 30-M1986, Clause 6.13	Hydrostatic pressure test of 20 / 800psi on the seal assembly to
	determine leakage / rupture of the seal.
C22.2 No 30-M1986, Clause 6.11	Hydrostatic pressure test of 1160psi on the seal housing.

Both tests have passed on both the 1" conduit seal and pressure sensor housing. These tests are considered to meet the intent of UL 1203.

No further testing was deemed necessary.

#### Project 1205874, Edition 3:

**GENERAL**: Due to the nature of the revised construction only the following tests were deemed necessary.

## **INTRINSIC SAFETY PROTECTION**

#### Antenna

DC is blocked from reaching the antenna by means of two blocking capacitors Manufacturer: Advanced Technical Materials, P/N B220-900/900 or Inmet Corp., P/N 8529A. These capacitors have passed a 500Vac dielectric test.

# **Protective Resistors**

Calculations show that all protective resistors operate as less than their power rating under normal and fault conditions, therefore no further evaluation was required.

No further testing or evaluation was deemed necessary.

## Project 1226172, Edition 4:

Part B: SA2000 with RTD, Solar Panel, Antenna

GENERAL: Due to the similarities with the SA100/2000 tested above only the followings tests were conducted.

## Temperature

Tested with lead acid battery discharged and simulated solar panel input for recharging at max current 0.37 A.

Thermocouple Locations	Max Deg C
Internal Battery Pack	27
Diode D6	35
Bat Chg Transistor Q3	39
Bat Chg Coil L1	37
Resistor R29	37
Resistor R3	38
Ambient	25

## **Conduit Seal Tests:**

Samples of the 3/4" conduit seal fittings (w/o potting compound) and the pressure core coupler were subjected to a hydrostatic pressure test of 580psi for a duration of 1 minute. Results: Satisfactory, there was no rupture of the body.

Samples of the 3/4" conduit seal fittings (c/w potting compound) were subjected to an air pressure leakage test. The test was conducted at 6" of water column with no air leakage noted.

Samples of the 3/4" conduit seal fittings (c/w potting compound) were subjected to a hydrostatic pressure test of 20, 800 and 1200 psi for a duration of 1 minute. Results are as follows:

20 psi no leakage of water through the seal 800 psi no rupture, or movement of the seal 1200psi no rupture or movement of the seal

The results are considered satisfactory.

#### **INTRINSIC SAFETY PROTECTION**

Solar Panel - see above in Part A.

## Solar Panel Input / Antenna

The Solar Panel is connected to CON5 on the RF Interface Board. This connector is used for connection of the solar panel as well as for connection to the RF antenna. A Thermal Fuse (F3) is used to limit the current from the Solar Panel going into the main circuitry. Two diodes (D5 and D6) also protect a IS Vexternal line that is connected to CON5. DC is blocked from reaching the antenna by means of two blocking capacitors (C13, C14) Manufacturer: Instec Corp., Cat No.: T1206NPO331KWT, Specification; 330 pF, 1000 V. The RF modem is limited to an output power of 4 W maximum. These capacitors are located on the RF Modem board. These Capacitors have passed a 500 Vac dielectric test.

# I/O Output

The RTD outputs are protected by the IS Resistors R1, R5-8, R11, R15-16 as shown on the wiring board schematic that are pcb board mounted before it exits the explosion proof enclosure assembly. The data, contact and pulse inputs / outputs are protected by resistors R12-14, R17, R19. All of these resistors are rated to be below their rated power under normal and fault conditions. Testing was performed to determine the maximum voltage that step up convertor U5 on the wiring board could produce under worst case circuit conditions. Component R31 was opened. This caused the output of the convertor to peak at 16.5Vdc and then achieve a steady state of 11.4 V after shorting the output of IS 12V RS485. The resistive network of R2-4 did not vary by more than 5% and the temperature stabilized on the resistors after ~1/2 h. These results were then used to perform the Intrinsically Safe analysis of the circuitry.

# **SPARK IGNITION**

Spark Ignition tests were waived due to the analysis showing a factor of safety of minimum 2.0 for all circuits involved.

# **TEMPERATURE CODE RATING**

Temperature Code ratings are only considered necessary on the accessories of the data logger & transmitter (solar panel, RTD, Antenna)

#### **PROTECTIVE RESISTORS**

Calculations show that all protective resistors operate at less than their power rating under normal and fault conditions, except as follows:

The following protective resistors were tested with a 24 Vdc applied voltage with the output shorted. <u>I.S. Protective Resistor Designation</u> <u>Results</u>

R11, R15, R16 (Cal Chip Part) R17, R19 (KOA Part) R17, R19 (SEI Part)

Resistance did not vary by more than 1% after one hour. Resistance increased over 20 seconds then part opened safely. Resistance increased over 20 seconds then part opened safely.

# **PROTECTIVE DIODES**

Calculations show that all protective diodes operate at less than their current rating under normal and fault conditions; therefore no further evaluation was required.

No further testing was deemed necessary.

# Project 1290433, Edition 5:

**<u>GENERAL</u>**: A summary of the revisions under this application are as follows:

1. Minor trace layout corrections of wiring board 11540 - no changes in I.S. critical layouts / spacings.

2. Minor trace / circuit revision to circuits 11539, 11537, 11536 - non critical circuits to I.S. or non-incendive protection.

3. Minor trace layout corrections of CSC modem wiring board 11256 - no changes in I.S. critical layouts / spacings.

4. Addition of small daughter board on CSC modem board 11256 - no effect on I.S. critical layouts / spacings.

5. Addition of Alternate 8 V internal battery and associated PSU circuit SC12347. The impact of this change is an increased energy available for the RS485 12 V dc bias converter under the fault conditions previously tested therefore the affected testing was repeated as follows:

# I/O Output

Testing was performed to determine the maximum voltage that step up convertor U5 on the wiring board could produce under worst case circuit conditions. Component R31 was opened. This caused the output of the convertor to peak at 18.5 Vdc and then achieve a steady state of 15.5 V after shorting the output of IS 12V RS485. The resistive network of R2-4 did not vary by more than 5% and the temperature stabilized on the resistors after  $\sim$ 3/4 h. These results were then used to perform the Intrinsically Safe analysis of the circuitry.

All other related previous intrinsically safe analysis remains valid.

6. Optional Classification of SA2000 with RTD 61X powered from Certified Model 110 battery unit with nonincendive output for use in Class I, Division 2, Groups C & D hazardous areas: The new combination and markings were evaluated to the Class I, Div.2 requirements. The previous testing and evaluation for intrinsic safety deemed the existing SA2000, RTD 61X suitable for use in Class I, Div. 2 areas when powered through the cable assembly P/N 12331 from the Certified Model 110 battery unit with non-incendive output

With the addition of the non-incendive external battery input the power interface at CON3 was evaluated for Class 1, Div. 2 applications. The output of the Model 110 external battery unit is limited to non-incendive levels as determined by test in application 1092548. The bulk head connector power input to the SA2000 is protected at CON3 by two blocking diodes D18, D19 to prevent a source of ignition at these terminals from the internal battery.

No further testing was deemed necessary.

#### Project 1318325, Edition 6:

Due to the similarity with previous Certified construction only the following tests were conducted.

# **ALTERNATE PROTECTIVE RESISTORS**

The following protective resistors were tested with a 24 Vdc applied voltage with the output shorted.I.S. Protective Resistor DesignationResultsR11, R15, R16 (SEI P/N RMC1-18)Resistance did not vary by more than 3% after one hour.R11, R15, R16 (PanasonicResistance did not vary by more than 2% after one hour.

P/N ERJ-1WXJ-180U) R11, R15, R16 (Panasonic P/N ERJ-1TYJ-180U)

Resistance increased over 10 minutes then part opened safely.

## KELLER 33 PROBE FLUID SEAL TESTS (200 & 400 BAR)

The Keller 33 Probe was subjected to the following hydrostatic test pressures for a duration of 1 minute with the following results

200BAR (Rated pressure) 5600PSI No Leakage 8300PSI No Rupture

400BAR (Rated Pressure) 10700PSI No Leakage 15600PSI No Rupture

This is considered satisfactory.

# **KELLER 33 PROBE NON-INCENDIVE CIRCUIT ANALYSIS**

Due to the Keller Probe being certified as EEx ia IIC T6 to T4 by LCIE for the European Market with Ci and Li parameters of 0uF and 0uH respectively, and the fact that the Probe is connected to the I.S. outputs of the Model SA2000, the Keller Probe can be considered as a non-incendive device for use in Class I, Division 2 without any further investigation.

No further testing was deemed necessary.

# **Project 1347384, Edition 7**: ENTITY PARAMETER EVALUATION

Entity parameters were assigned to the RS485 and pulse/contact outputs. Since the RS485 connection can both receive and transmit power, both input and output entity parameters must be assigned.

#### PULSE / CONTACT

The maximum output voltage has been determined at 18.5V based on the maximum internal convertor voltage under fault conditions. The maximum short circuit current of 21mA is based on the maximum output voltage divided by limiting resistance. The maximum capacitance that can be safely connected at 18.5V is 1.67uF for a Group C and D atmosphere. Since there are multiple connections that can be used in parallel (2 pressure sensors, 2 RS485 connections, RTD connection and 3 pulse/contact connections) the total capacitance must be divided between the connections. Therefore since the RTD and pressure sensor are known entities without internal capacitance of their own only cable parameters need to be included in the calculations. Therefore there are 3 cables + 5 Ca additions. Ca has been calculated at 280nF (1.67uF - 270nF for cables / 5 entity connections). Inductance has been calculated similar to the above and is 250uH.

#### RS485

The maximum output voltage has been determined at 18.5V based on the maximum internal convertor voltage under fault conditions. The maximum short circuit current of 174mA is based on the maximum output voltage divided by limiting resistance. The maximum capacitance that can be safely connected at 18.5V is 1.67uF for a Group C and D atmosphere. Since there are multiple connections that can be used in parallel (2 pressure sensors, 2 RS485 connections, RTD connection and 3 pulse/contact connections) the total capacitance must be divided between the connections. Therefore since the RTD and pressure sensor are known entities without internal capacitance of their own only cable parameters need to be included in the calculations. Therefore there are 3 cables + 5 Ca additions. Ca has been calculated at 280nF (1.67uF - 270nF for cables / 5 entity connections). Inductance has been calculated similar to the above and is 250uH.

The Maximum input voltage has been calculated so that the internal 5 Ohm resistors will remain protective. Therefore 12V has been chosen as it will only dissipate a maximum of 2/3Power on the resistors. Since the voltage is the limiting factor, the current can be set arbitrarily. Up to two Polartek 2000 Informers may be connected and each informer has an Isc rating of 390mA making the combined total of 780mA. Therefore 1A was chosen for the Imax value. Since the equipment uses protective resistance, Ci and Li = 0.

No further evaluation was required.

# Project 1347380, Edition 8:

Part B: SA2000 with optional Fuji DP/GP Cores and New External Div. 2 Model 63X Modem.

**GENERAL**: Due to the similarities with the SA2000 tested above only the followings tests were conducted.

#### SA2000 With New Fuji Cores:

# PROTECTIVE RESISTORS

<u>New FIC Wiring Board</u>: All protective resistor combinations used on the new FIC wiring board were previously evaluated on the previous wiring board (same values).

<u>New RS232 Wiring Board</u>: Calculations show that all protective resistors operate at less than their power rating under normal and fault conditions or were tested previously (see above), except as follows:

I.S. Protective Resistor DesignationResultsThe following protective resistors were testedwith a 24 Vdc applied voltage with the output shorted.R14-16, R20-22, R39-46 (Panasonic Part)Resistance did not vary by more than 5% after one hour.

# **<u>3 WAY MAINFOLD X-PROOF TESTS</u>**

## EXPLOSION PRESSURE TESTS (Group C)

Explosion pressures were measured in the 3-way manifold under the following conditions Five tests with a gas mixture of 8.0% Ethylene in air, no conduit attached. Ten tests with a gas mixture of 4-9% Ethylene in air, no conduit attached.

A maximum pressure of 98.9 PSI was recorded.

## FLAME PROPAGATION TESTS (Group C)

Flame propagation tests were performed under the following conditions: Five tests using 37% Hydrogen in air, no conduit attached, no gaskets installed, 1 atmosphere, no joint reductions.

Results: Satisfactory, there was no propagation to an external atmosphere.

## HYDROSTATIC PRESSURE TESTS

A hydrostatic test pressure of 395.6PSI (4\*98.9PSI) was applied to the 3-way manifold for a duration of 1 minute.

Results: Satisfactory, there was no visible signs of deformation of the manifold.

## **INTRINSIC SAFETY PROTECTION**

## Alternate RS232 Interface / Solar Power Input (PC Board 12462)

Based on a maximum charge on the internal battery of 9.4Vdc, the maximum energy that can be delivered into the I.S. cable between the Smart Alek and the External Modem is 433.3mA.

## **PROTECTIVE DIODES**

Calculations show that all protective diodes operate at less than their current rating under normal and fault conditions, therefore no further evaluation was required.

Part D: Model 63X External Div. 2 Model 63X Modem.

#### Temperature

Tested with internal lead acid battery discharged and simulated solar panel input for recharging at max current 0.37 A.

Thermocouple Locations	Max Deg C
Diode D3	25
Coil L2	25
Coil L1	29
Resistor R66	30
Diode D32	25
Diode D27	26
Diode D26	25
Diode D20	24
Diode D15	24
Diode D10	23
Diode D18	24
Diode D19	24
Diode D11	24
Diode D8	24
Diode D13	24
Diode D14	25
Diode D12	25
Diode D9	26

Diode D16	27
Fuse F2	24
Cap C17	26
Cap C35	24
9522 Modem Enclosure Top	22
9522 Modem Enclosure Bottom	22
Battery	22
Ambient	22

# **NON-INCENDIVE EVALUATION**

#### **Class I, Div. 2 Evaluation**

#### General

- Unit input / output connectors are locking and / or screw secured type and obviously comply with the 15N requirements. Markings of Cl. 5.3 are included as the circuits are deemed incendive circuits.
- Battery connector complies with 15N requirement and is marked regarding disconnection / replacement.
- Modem interface board connectors are all locking type that comply with the 15N requirement.
- Internal OEM 9522 Modem has no connectors that can be opened without mechanically disassembling the unit. The internal 4 pin mini-Molex harness identified as J3 is additionally secured with RTV silicone to prevent accidental dislodging under a 15N force.

#### Non-Incendive Contact Calculations:

- a) Switch S2 on External Modem PCB: 8 V dc / 422 kohm + 3.3 V dc / 100 kohm = 52 uA resistive.
- b) Switch S1 on External Modem PCB: 25 V dc / 100 kohm + 25 V dc / 100 kohm = 500 uA resistive.

Conclusion: These values are below the ignition curves for Div. I, Grps C & D gases.

#### **INTRINSIC SAFETY PROTECTION**

#### Alternate RS232 / Solar Panel Input (PC Board 12464)

Based on a maximum charge on the internal battery of 9.4Vdc, the maximum energy that can be delivered into the I.S. cable between the Smart Alek and the External Modem is 840mA. This is the combined current from the RS232 and Solar Panel outputs.

#### **PROTECTIVE DIODES**

Calculations show that all protective diodes operate at less than their current rating under normal and fault conditions, therefore no further evaluation was required.

## Hosedown: C22.2 No 94-M91, Cl 6.8.3

Conducted on Hoffman enclosure with Accepted type TNC RF and Solar DIN connector.

240L/Min for a period of 5 Min. – Pass

## **COMBINED I.S. PARAMETERS FROM THE SMART ALEK AND EXTERNAL MODEM**

The combined parameters from the Smart Alek and the External Modem are calculated as follows:

Voltage = 11.2V Requivalent =  $8.79\Omega$  Current = 1.27A

This is acceptable for use in a Group C and D environment as there is no appreciable inductance or capacitance added to the circuit from the cable.

No further testing was deemed necessary.

## Project 1397404, Edition 9:

<u>**GENERAL**</u>: The following is the evaluation of the new 10 W Div. 2 Solar Panel option & Alternate Keller low pressure probe option.

## **Temperature Code – Cl 6.3**

In order to determine that the temperature code rating on the External Div. 2 Modem Model 63X was not adversely affected by the higher charging current available from the 10 W solar panel option the following was repeated: Tested with internal lead acid battery discharged and simulated solar panel input for recharging at max current 0.614 A.

Thermocouple Locations	Max Deg C
Diode D3	25
Coil L2	26
Coil L1	31
Resistor R66	31
Diode D32	26
Diode D27	27
Diode D26	26
Diode D20	24
Diode D15	24
Diode D10	24
Diode D18	25
Diode D19	25
Diode D11	24
Diode D8	24
Diode D13	25
Diode D14	25
Diode D12	25
Diode D9	27
Diode D16	27
Fuse F2	24
Cap C17	26
Cap C35	25
9522 Modem Enclosure Top	22

9522 Modem Enclosure Bottom	22
Battery	25
Ambient	22

## **NON-INCENDIVE EVALUATION – Model 640 Solar Panel Barrier**

#### **Class I, Div. 2 Evaluation**

## <u>General</u>

- Input / output connectors are locking type and obviously comply with the 15N requirements.

# **Temperature Code – Cl 6.3**

In order to determine that the temperature code rating the barrier was loaded to the maximum available current from the 10 W solar panel option (0.614 A).

Thermocouple Locations	Max Deg C
Ceramic Resistor Type SQP10A	95
Enameled Resistor Type 10R20J	119
In5821 Diode	66
Ambient	40

Result: Based on the above a T-Code rating of T4A was assigned to this apparatus.

# **PROTECTIVE DIODES**

Calculations show that all protective diodes operate at less than their current rating under normal and fault conditions, therefore no further evaluation was required.

# **INTRINSIC SAFETY PROTECTION**

Calculations of each ST-5 5 W solar panel indicated that each panel had an internal source resistance of 32.9 ohms with 22.9 Voc available. With the additional 10 ohm / 10 W part the output was limited to 0.614 A Isc @ 22.9 Voc. This limits the IS output to a level acceptable for Div. 1, Grps C & D. At 0.614 A Isc the 10 ohm / 10 W resistor was well within its rated power at 3.8 W maximum.

#### KELLER 33 PROBE FLUID SEAL TESTS

The alternate low pressure version of the Keller 33 Probe has the same pressure containing features as that previously tested and differs only in process connection size.

# KELLER 33 PROBE NON-INCENDIVE CIRCUIT ANALYSIS

The alternate low pressure version of the Keller 33 Probe has the same electronic circuitry as previously evaluated.

No further testing was deemed necessary.

# Project 1437439, Edition 10:

**<u>GENERAL</u>**: The evaluating testing / evaluations were conducted to:

- Accept new surge arrestor on Model 620 solar panel assembly
- Accept alternate casting material on x-proof 3 way manifold P/N 12606
- Accept revised flame path profile on manifold coupler 12926 / 12928 (previously P/N 12607)
- Add new Model 631 Div. 1 external modem
- Add new Model 690 Div. 2 external battery

## Surge Arrestor For Model 620 Solar Panel:

- The additional circuit capacitance (20 nF) and inductance (10 uH) do not adversely affect the previous IS acceptance of the IS associated circuits.

## Alternate Casting Material For X-Proof Manifold P/N 12606:

- The originally tested manifold was cast from an ASTM grade 356.1 aluminum (recycled material). A review of published specifications for the alternate material ASTM grade 356.2 indicates that the 356.2 provides better casting quality (e.g. lower porosity), higher tensile and ultimate yields. As such this alternate material was accepted without further testing.

## Revised Flame Path Profile For The Fuji Coupler P/Ns 12926 / 12928 (Previously 12607):

- The original coupler, P/N 12607, was modified as shown in drawings 12926 / 12928 to accept two o-rings for environmental sealing purposes. A review of the previous flame path propagation and hydro testing conducted indicated that the original testing was conducted on the 3 way manifold with two machined end plugs that had an equivalent or reduced flame path when compared to the new coupler profile. Based on this the new coupler profile was accepted without further testing.

## Part E: Model 631 Div. 1 External Modem

- Due to the similarity with the model 63X modem previously tested and the use of approved Class I, Div. 1 components in the assembly, no further testing was conducted.

# Part F: Model 690 Div. 2 External Battery

#### **Temperature Code – Cl 6.3**

In order to determine that the temperature code rating on the External Battery Model 690 the unit was tested with a discharged 55 Ah battery, solar charge input set at a fixed 22.9 Voc, 0.614 Asc (max per 2 X 5W option) SA2000 power output set at rated 400 mA constant current load.

Thermocouple Locations	Max Deg C
Connector CON1	28
Connector CON2	26
Transistor Q1	25
Cap C1	29
Cap C2	30
Diode D1	37
Diode D3	35
Diode D6	32
Diode D7	31
Diode D8	32
Resistor R7	54
Resistor R29	55
Battery	22
Ambient	22

Based on the above the implied T-Code rating of T4 was acceptable.

## **NON-INCENDIVE EVALUATION**

# **Class I, Div. 2 Evaluation**

## General

- PC Board input / output connectors are locking type and obviously comply with the 15N requirements.

- Switch S1 is limited to 4.7 V / 1100  $\Sigma$  = 4.27 mA, meets resistive non-incendive limits.

## **Protective Diodes**

Calculations show that all protective diodes operate at less than their current rating under normal and fault conditions, therefore no further evaluation was required.

#### **Intrinsic Safety Protection**

The IS power output to the SA2000 is limited to 14.4 Voc, 1.943 Asc.

The following protective resistors were tested with an applied current of 200% of F1 (0.75 A) = 1.50 A for 1 h.

<u>I.S. Protective Resistor Designation</u> R7, R29 (Yageo P/N SQP10AJB-3R9) R7, R29 (NTE P/N NSP10 3.9R 5%) R7, R29 (SEI/RCD P/N NSP10 3.9R 5%) R7, R29 (IRC P/N PW10 3.9R 5%) <u>Results</u> Resistance did not vary by more than 5.4% after one hour. Resistance did not vary by more than 1% after one hour. Resistance did not vary by more than 1% after one hour. Resistance did not vary by more than 1% after one hour.

# Project 1557377, Edition 11:

Under Edition 11 an alternate, updated version of the Keller Model 33EI / 35EI pressure sensor was added, Keller AG Models 33XEI & 35XEI. The new alternate models are similar to the previous Model and differs only in minor electronic changes.

# KELLER 33XEI / 35XEI PROBE NON-INCENDIVE CIRCUIT ANALYSIS

Due to this Keller Probe also being certified as EEx ia IIC T6 to T4 by KEMA for the European Market with Ci and Li parameters of 50nF maximum and 0uH respectively, and the fact that the Probe is connected to the I.S. outputs of the Model SA2000, the Keller Probe can be considered as a non-incendive device for use in Class I, Division 2 without any further investigation. Note: Unit configuration jumpers J01, J02 and J2 are soldered in for the 35XEI and are not considered as potentially arcing parts.

No further testing was deemed necessary.

#### Project 1608983, Edition 12:

Update to include alternative:

- modem adapter boards (RF modem/Solar panel power/interface boards),
- internal radio modems (dual frequency band cellular modems),
- surge arrestor (dual frequency band, external, Div. 2, bias T circuit),

- solar panel

The following summarizes the analysis of the alternative construction:

#### Alternate RF modem/Solar panel power interface boards, #2 & #3;

The Solar Panel is connected to CON5 on the RF Interface Board, as previously evaluated.

IS output / input components are similar to previously evaluated

Except circuit capacitance, C22 (330 pF) is eliminated.

Circuit inductance, L4 is reduced from 22uH to 39nH.

This reduces the potential ignition energy and is deemed to be acceptable.

The alternative RF modems (intended for these alternate boards) are limited to a maximum output power of 0.5 W.

# Alternate Surge Arrestor For Model 620 Solar Panel (Dual RF Band):

The alternate Type BTL-C05 bias T component adds an additional circuit capacitance of 2 nF maximum and circuit inductance of 2 uH maximum, this is  $\sim 20\%$  of what was previously accepted and is therefore acceptable without further testing.

# Alternate Solar Panel #1 – 'BP Solar', Model SX 5

This alternate solar panel is rated at 20.5Voc, 0.3A Isc.

The maximum safe parameters for use in Group C are 21.0V and 1.004A (1.0 factor) and 0.670A (1.5 factor).

The solar panel has a factor of safety of at least 3.4 based on the solar panel output and required current for ignition.

Therefore the Solar Panel can be considered as providing an IS source for use in Class I, Groups C and D.

# Alternate Solar Panel #2 – 'SunWize Technologies', Model OEM 5

This alternate solar panel is rated at 20.5Voc, 0.38 A Isc.

The maximum safe parameters for use in Group C are 21.0V and 1.004A (1.0 factor) and 0.670A (1.5 factor).

The solar panel has a factor of safety of at least 3.3 based on the solar panel output and required current for ignition.

Therefore the Solar Panel can be considered as providing an IS source for use in Class I, Groups C and D.

No further testing was deemed necessary.

# Project 1637957, Edition 13:

# Part E: Model 631 Div. 1 External Modem

- Due to the similarity of the previous modem evaluated and the exclusive use of this alternate in the approved Class I, Div. 1 assembly, no further testing was conducted.

# Project 1666664, Edition 14:

Update to certificate 1153379 to include alternative:

- Certified 'Fuji' low pressure core part numbers
- Model 622 Solar Panel
- Model 621 Solar Panel / Model 641 IS Barrier (For 2 X 5 W Configurations)
- Surge arrestor (dual frequency band, external, Div. 2, bias T circuit)

The following summarizes the analysis of the alternative construction:

# Alternate 'Fuji' Low Pressure Core Part Numbers:

- The subject additional pressure cores were tested and continue to be CSA Certified under the OEM's CSA Certification Report 1126110 – attestation on file at CSA Edmonton.

# Model 621 Solar Panel - 'BP Solar', Model SA 5 LV

This alternate solar panel is rated at 21.9 Voc, 0.44 A Isc. The maximum safe parameters for use in Group C are 21.9 V and 0.876 A (1.0 factor) and 0.584 A (1.5 factor). The solar panel has a factor of safety of 1.99 based on the solar panel output and required current for ignition. Therefore the Solar Panel can be considered as providing an IS source in Class I, Groups C and D. The existing BP Solar SA-5 LV FM Approved T-Code of T3C was used for the Model 621 assembly markings.

## Model 622 Solar Panel – 'BP Solar', Model SA 5

This alternate solar panel is rated at 24.8 Voc, 0.41 A Isc. Calculating the source impedances of the new BP SA-5 panel + the min 2.2 ohm IS limiting resistor (-5%) = 62.578 ohms total series resistance at 24.8 V = 0.396 A. The maximum safe parameters for use in Group C are 24.8 V and 0.601 A (1.0 factor) and 0.400 A (1.5 factor). The solar panel has a factor of safety of 1.52 based on the solar panel assembly output and required current for ignition. Therefore the Solar Panel can be considered as providing an IS source in Class I, Groups C and D. The existing BP Solar SA-5 FM Approved T-Code of T3C was used for the Model 622 assembly markings.

## Temperature Code - Cl 6.3 - Model 622 Solar Panel IS Resistor

Calculations for the Model 622 solar panel IS limiting resistor indicates the following:

- i) A maximum calculated dissipation under worst case condition (shorted output) of 0.344 W for the minimum specified 2.2 ohm part and;
- ii) A maximum calculated dissipation under worst case condition (shorted output) of 0.417 W for the maximum specified 2.7 ohm part.

Result: As the resistor is a 2 W rated part used at max 21% of rated power and the solar panel assembly is T-Code rated T4, no further evaluation was required.

# NON-INCENDIVE EVALUATION – Model 641 Solar Panel Barrier

#### **Class I, Div. 2 Evaluation**

# <u>General</u>

- Input / output connectors are locking type and obviously comply with the 15N requirements.

# **Temperature Code – Cl 6.3**

In order to determine that the temperature code rating the barrier was loaded to the maximum available current from the 10 W solar panel option (0.490 A).

Thermocouple Locations	Max Deg C
Ceramic Resistor Type SQP10AJB-22R	117
Enameled Resistor Type 20J22R	133
In5821 Diode	67
Ambient	40

Result: Based on the above a T-Code rating of T4 was assigned to this apparatus.

# **INTRINSIC SAFETY PROTECTION**

Evaluation of the new Model 641 IS Barrier with 2 X 5 W Solar Input (BP Solar SA-5 LV Series only) @ 21.9 Voc, 0.44 A Isc (X2). Calculating the parallel source impedances of the two new BP SA-5 LV panels + the 22 ohm resistor (-10%) = 49.772 ohms total series resistance at 21.9 V = 0.490 A. This limits the IS output to a level acceptable in Class I, Grps C & D. The maximum safe parameters for use in Group C are 21.9 V and 0.876 A (1.0

factor) and 0.584 A (1.5 factor). This IS barrier output has a factor of safety of 1.79 based on the barrier output and required current for ignition. At 0.490 A Isc the 22 ohm / 10 W resistor was well within its rated power at 5.3 W maximum.

# Surge Arrestor For Model 621 Solar Panel Assembly:

The alternate `Microlynx' Bias T assembly adds an additional circuit capacitance of 100 pF maximum and circuit inductance of 27 nH maximum, this is < 1% of what was previously accepted and is therefore acceptable without further testing.

# Hosedown: C22.2 No 94-M91, Cl 6.8.3

Conducted on Alternate Surge Arrestor (S/N 008) enclosure with Accepted type TNC / N RF and Solar DIN connector.

240L/Min for a period of 5 Min. - Pass

# Project 1711873, Edition 15:

Update to certificate 1153379 to include:

- Minor Report Corrections

- Updated Solar Panel 620 Manufacturer (Shell Type ST5)

- Updated Model 641 IS Barrier Ratings For Use With Model 620 Solar Panels

- Updated Installation Drawing For Above Solar Panel Changes & Equivalent Certified `NuFlo' MC-III EXP Ex / IS Replacement Flow Meter

The following summarizes the analysis of the alternative construction:

# Alternate Model 620 Solar Panel – 'Shell Solar', Model ST5

This alternate solar panel is rated at 22.9 Voc, 0.39 A Isc. The maximum safe parameters for use in Group C are 22.9 V and 0.757 A (1.0 factor) and 0.505 A (1.5 factor). The solar panel has a factor of safety of 1.94 based on the solar panel output and required current for ignition. Therefore the Solar Panel can be considered as providing an IS source in Class I, Groups C and D.

# **INTRINSIC SAFETY PROTECTION** – Model 641 IS Barrier With Model 620 Panels

An evaluation of the Model 641 IS Barrier with 2 X 5 W Model 620 Solar panel inputs yield the following parameters. Calculating the parallel source impedances of the possible solar panels + the 22 ohm barrier resistor (-10%) yields the following for the three sources of panels:

Shell Solar Type ST5 = 49.159 ohms total series resistance at 22.9 V = 0.466 A. This limits the IS output to a level acceptable in Class I, Grps C & D. The maximum safe parameters for use in Group C are 22.9 V and 0.757 A (1.0 factor) and 0.505 A (1.5 factor). This IS barrier output has a factor of safety of 1.62 based on the barrier output and required current for ignition. At 0.466 A Isc the 22 ohm / 10 W resistor was well within its rated power at 4.8 W maximum.

BP Solar Type SX5 = 53.97 ohms total series resistance at 20.5 V = 0.380 A. This limits the IS output to a level acceptable in Class I, Grps C & D. The maximum safe parameters for use in Group C are 20.5 V and 1.087 A (1.0 factor) and 0.724 A (1.5 factor). This IS barrier output has a factor of safety of 2.86 based on the barrier output and required current for ignition. At 0.380 A Isc the 22 ohm / 10 W resistor was well within its rated power at 3.2 W maximum.

SunWize Type OEM 5 = 46.77 ohms total series resistance at 20.5 V = 0.438 A. This limits the IS output to a level acceptable in Class I, Grps C & D. The maximum safe parameters for use in Group C are 20.5 V and 1.087 A (1.0 factor) and 0.724 A (1.5 factor). This IS barrier output has a factor of safety of 2.48 based on the barrier output and required current for ignition. At 0.438 A Isc the 22 ohm / 10 W resistor was well within its rated power at 4.2 W maximum.

Based on the above calculations, the Model 620 Solar Panel Input Ratings added to the Model 641 barrier of 22.9 Voc / 0.466 A maximum were deemed acceptable.

# **Temperature Code – Cl 6.3**

The Model 641 temperature code rating remains unchanged at T4 from that previously tested under Project 1666664, Edition 14. As the maximum short circuit current available in the new configuration with Model 620 solar panels is less at 0.466 A maximum; which is 24 mA less than what it was temperature coded for previously (0.490 A), no further evaluation or testing was deemed necessary..

Result: Based on the above, the existing T-Code rating of T4 remains acceptable.

# ENTITY PARAMETER EVALUATION – Alternate RS485 Connected Flow Analyzer Type MC-III EXP

As the Certified\* 'NuFlo' MC III EXP is a direct replacement for the previously evaluated & accepted Polartek 2000 'Informers' and the protective features and IS parameters for the RS485 I/O on the MC-III EXP have not changed, no further evaluation was required.

#### Project 1729598, Edition 16:

Update to report 1153379 to include retesting of Fuji pressure Cores and add new construction of Model 622 Solar panel assembly.

The following Fuji pressure cores were retested with the Maximum Working Pressures used as a reference for each:

Model 0-32kPa DP – 2175psi Model 0-130kPa DP – 2500psi Model 0-10MPa GP – 2175psi

Sample	Maximum Working Pressure (psi)	Test Pressure (psi)	Actual Pressure (psi)	Duration	Pass/Fail	Comments
0-32kPa DP	2175	4314	4320	1 min	PASS	No Leakage
0-32kPa DP	2175	6453	6460	1 min	PASS	No Leakage
0-130kPa DP	2500	4883	5000	1 min	PASS	No Leakage
0-130kPa DP	2500	7266	7280	1 min	PASS	No Leakage
0-10MPa GP	2175	4314	4320	1 min	PASS	No Leakage
0-10MPa GP	2175	6453	6460	1 min	PASS	No Leakage

#### NOTES:

Ambient Temperature – Room Temperature

Pressure was applied through one port on the high side; the other was plugged

RESULTS: The tested Fuji Pressure Cores may be marked with the matching Maximum Working Pressures.

The solar panel assembly drawing (Illustration 114) added to include optional assembly instructions to enhance manufacturability of the solar panel cable (addition of current limiting resistor to ensure intrinsic safety). Resistor location moved to end of 22" cable. Modification acceptable as cable is used as per Drawing 12397 (Illustration 66) and will not enter Division 1 area.

The original solar panel assembly drawing (Illustration 113) updated to correct errors found in original drawing

No further testing as deemed necessary.

# Project 1747130, Edition 17:

Update to report 1153379 to include an alternate GSM modem and alternate solar panel assemblies.

## Alternate Solar Panel Assembly (Model 621)

An alternate solar panel assembly drawing (Illustration 118) was added to include optional assembly instructions (addition of current limiting resistance in the cable). The modification is acceptable as this is an addition of current limiting resistance to an assembly not requiring additional protection. This assembly is identical to the assembly described in Illustration 113 for the Model 622 solar panel assembly.

## Alternate Solar Panel Assembly (Model 622)

An alternate solar panel assembly drawing (Illustration 114) was updated added to include optional assembly instructions to enhance manufacturability of the solar panel cable (addition of current limiting resistor to ensure intrinsic safety). Resistor location is still at the end of 22" cable. The modification is acceptable as the cable is used as per Drawing 12397 (Illustration 66) and will not enter Division 1 area. A construction analysis showed that spacing requirements were maintained by using this method of construction

#### Alternate RF modem/Solar panel power interface boards, #4;

The Solar Panel is connected to CON5 on the RF Interface Board, as previously evaluated.

IS output / input components are similar to previously evaluated

Except blocking capacitors C13 and C14 are reduced to 33pF from 330pF. Testing on the capacitors was performed in a CSA witnessed test. The capacitors each passed a 500VAC dielectric strength test Circuit inductance, L2, remains at 39nH.

This is deemed to be acceptable.

The alternative RF modem (Siemens, Cat No. Type TC63) is rated to a maximum output power of 2W.

No further testing was deemed necessary

# Project 1781718, Edition 18:

Update to report 1153379 to evaluate alternate solar panels and changing the ambient temperature rating to  $-40^{\circ}$ C to  $+60^{\circ}$ C

# **INTRINSIC SAFETY PROTECTION**

# **Alternate Solar Panel Evaluation**

# Alternate Solar Panel #3 – 'Star Power Intl. Ltd', Model CTI-05

This alternate solar panel is rated at 20.5Voc, 0.30A Isc.

The maximum safe parameters for use in Group C are 20.5V and 1.087A (1.0 factor) and 0.724A (1.5 factor).

Based on these values, the Solar Panel can be considered as providing an IS source for use in Class I, Groups C and D.

# Alternate Solar Panel #4 – 'Yuhuan Green Power Trading Co. Ltd.', Model GP5-36 / GP5-36M

This alternate solar panel is rated at 21.3Voc, 0.30A Isc.

The maximum safe parameters for use in Group C are 21.0V and 0.959A (1.0 factor) and 0.639A (1.5 factor).

Based on these values, the Solar Panel can be considered as providing an IS source for use in Class I, Groups C and D.

# **CHANGING OF AMBIENT TEMPERATURE RATING ON SA2000 and MODEL 631**

EXPLOSION-PROOF EVALUATION

The following testing was deemed necessary on the enclosures of the SA2000 (Adalet-PLM Scott Fetzer Co XDH series with sight glass cover on one end) and Model 631 (Adalet-PLM Scott Fetzer Co XIFC 041204 series) to satisfy requirements beyond the temperature ratings of the certified enclosures:

CSA Standard C22.2 No. 30M1986 Clause 6.5 – Flame Propagation at elevated temperature (+60°C) UL Standard 1203, 3<sup>rd</sup> Edition – Clause 18 – Explosion pressure to determine hydrostatic pressure value UL Standard 1203, 3<sup>rd</sup> Edition – Clause 19 – Hydrostatic pressure test using the cold temperature factors of table 19.1

Results: SATISFACTORY.

Full test results are retained in the Engineering file for CSA Project 205470-1781718

Based on the above testing, the enclosures were deemed acceptable for use in an ambient temperature range of  $-40^{\circ}$ C to  $+60^{\circ}$ C. No further explosion testing was deemed necessary.

# INTRINSICALLY SAFE RATINGS EVALUATION

The IS Safety critical components of the SA2000 (Part B and C) and the Model 631 (Part E) were reevaluated for their suitability in an ambient temperature range of up to 60°C. All components were found to have a temperature delimiting rating higher than the specified 60°C ambient.

No further testing was deemed necessary.

# Project 1882538, Edition 19:

Update to Report 1153379 to include Model 661 Sensor (previously evaluated for the SA2005). Name change of Solar panel manufacturer.

# Model 661 sensor

Manufacturer: Keller A.G.

<u>Cat. No.: Series 35X Ei Digitally Compensated Pressure Transmitter</u> Specification: KEMA ATEX type approved for EEx ia IIC T6 to T4, CSA evaluated for use in Class I, Div. 1, Groups C & D. Ratings: 4-20 mA or 0-10 V, Ci = 0 (supply & current output) 50 nF (RS485 & voltage output); Li = 0; Ui <22 V; Pi < 1.2 W; Ii < 200 mA.

## **Illustration replaced:**

Illustration 66 - Installation Drawing for Div 1. and Div 2. Applications Including Entity Parameters; Drawing number 12397 Rev.12 (13 pages). – Addition of Model 661 sensor, evaluated to entity parameters and found acceptable.

Sensor accepted based on KEMA certification, meets entity parameters and installation instructions, no testing required.

Change of Company name for Alternate Solar Panel #4 – 'Yuhuan Green Power Trading Co. Ltd.', to 'Yuhuan Sinosola Co.,Ltd.' Model numbers (removed model **GP5-36M**), ratings are identical therefore no testing required.

#### Project 1882538, Edition 20:

Update report 1153379 to include Single Seal Marking as per ANSI/ISA 12.27.01 testing conducted under project 205470-2010868.

Extensive testing was done on a series of sensor modules under project 205470-2010868 including samples representative of the sensor modules used by the SA2000 assembly. See the table below for a correlation of which corresponding Fuji and Keller models are represented by the sensor module tested and its respective maximum working pressure (MWP):

Sensor Description	Fuji Model Number	Fuji Drawing Number	Representative Samples Tested	MWP Tested
GP Sensor 10MPa (1450psi) Fuji	FZPXFKG4-C040	TK4G8789C1	FKG#04(FCX-AII)	10 MPa
GP Sensor Module 500 kPa (72.51psi)	FZPXFKG4-C020	TK4G8789C3	S/N: HQB4789	
DP Sensor 130KPa (521.9"wc) Fuji	FZPXFKC4-B050	TK4G8790C2		18 MPa
DP Sensor 32KPa (128.5"wc) Fuji	FZPXFKC4-B030	TK4G8790C1	FKC#3#(FCX-AII) S/N: 40C2356	
DP Sensor Module 6kPa (24.09" wc)	FZPXFKC4-B020	TK4G8790C3		
GP Sensor 50MPa (7251psi) Fuji	FZPXFKG4-C050	TK4G8789C2	FKG#05(FCX-AII) S/N: JJ50796	

Sensor Description	Keller Part Number	Keller Drawing Number	Representative Samples Tested	MWP Tested
200 Bar Keller RS485, PA35Ei, AS100 oil, G-1/2" with 15' cable	233515.0006	81876.32		40 MPa
400 Bar Keller RS485, PA35Ei, AS100 oil, G-1/2" with 15' cable	233515.0010	81876.32	233515.0036	
200 Bar Keller, RS 485 Sensor, C1D1, PA-35XEi	233515.0036	81876.32	S/N: 85675	
400 Bar Keller, RS 485 Sensor, C1D1, PA-35XEi	233515.0037	81876.32		

During the testing performed under project 205470-2010868 representative samples were subjected to Temperature Cycling and Fatigue Cycling before being pressure tested for Rupture and Leakage as per the requirements of ANSI/ISA 12.27.01. The worst case Maximum Working Pressure rating was used for each given group. As a result the above listed sensor assemblies are acceptable to be used within their tested pressure limits.

The Model SA2000 when used with the sensor models above can therefore be marked with the term Single Seal.

Please note the four Keller sensors 233515.0006, 233515.0010, 233515.0036 and 233515.0037 are components which have their own labels. As per the testing performed under project 205470-2010868, the four sensors can now bear the term "Single Seal". The Fuji sensors are part of and remain part of the SA2000 assembly and are not labeled individually.

Drawings were added which cover the BOM's of all the Single Seal tested models. Long naming convection was used by Zed.i's quality control system so the drawings were added as figures instead of illustrations.

No further testing was deemed necessary.

## **Project 2267489, Edition 21:**

Update report 1153379 to include new modem, new solar panels and new RTDs.

#### Addition of Alternate Modems:

Change the name of manufacturer of TC63 from Siemens to Cinterion. Acceptable based on there being no change in the equipment. Siemens rebranded wireless equipment to Cinterion.

The addition of Cinterion Modem Model TC63i was deemed acceptable with no further testing deemed necessary. The IS protection of the circuit is not affected by the addition of this alternate modem output DC is still blocked by C13 and 14 on RF input / output board.

#### Addition of new Modem to Model 631 External Satellite Modem

The following satellite modem was added to the Model 631: 'Iridium ', 9522B Satellite Series, rated 4.4 V dc; average RF output power during maximum transmission slot is 4 W. This component was also evaluated and found acceptable for use in CSA report 205470-1662358.

The application of the modem for use in this application is the same as in application 1662358 where it stated that "An evaluation of the modem showed that there are no incendive components within the modem. The IS protection provided by the Modem I/O PCB is unchanged. The Modem is connected to the Modem I/O PCB and its antenna is installed in a Division 2 area. No further testing was deemed necessary"

No further testing was deemed necessary.

#### Addition of new solar panels

The following solar panels were added as part of this update:

BP Solar - SX-305M Innergy Power Corporation - IP5F Kyocera - KS5

An evaluation of the open circuit voltage and the short circuit current of each solar panel proposed showed that their parameters are below the parameters of previously certified panels

No further testing or evaluation was deemed necessary.

# Addition of new RTDs

Added new RTDs built by any manufacturer that builds the RTD in accordance with Zedi drawings MD12478, MD12495, MD12765, MD12766 and MD12767. Construction of the RTDs was examined and found acceptable

No further testing was deemed necessary.

#### END OF REPORT