



The Standard of Measurement

TCS 3000_{ex}

ELECTRONIC REGISTER



Installation Manual

Electrical Considerations and Regulatory Requirements



A battery is soldered to the CPU board and provides nonvolatile data storage and time/data retention. This battery should last between ten and thirteen years and is a factory replaceable part. This battery must be replaced with Renata, model CR2477N only. Use of another battery may present a risk of fire or explosion.



The use of supply wires suitable for 10°C above surrounding ambient is required. Total Control Systems recommends wire rated to 70°C or greater to meet this requirement.

This equipment is suitable for use in Ex Zone I Group IIB locations, and non-hazardous locations.



WARNING: TO REDUCE THE RISK OF IGNITION OF HAZARDOUS ATMOSPHERES, conduit runs must have a sealing fitting connected within 18 inches of the enclosure.



WARNING: TO REDUCE THE RISK OF IGNITION OF HAZARDOUS ATMOSPHERES, disconnect from the supply circuit before opening enclosure. Keep tightly closed when circuits are live.



WARNING: TO REDUCE THE RISK OF IGNITION OF HAZARDOUS ATMOSPHERES, A seal must be applied within 20mm.



WARNING: Substitution of components may impair intrinsic safety.



WARNING: Consult installation manual for required cable entry size and thread.



WARNING: If there are unused holes, blanking elements satisfying the flameproof 'db' method of protection must be used. Blanking elements must be removable with the aid of a tool, ATEX and IECEx certified, suitable for Gas Group IIB and suitable for an ambient temperature range of -40C to +60C, and also IP66 rated.

Underwriters Laboratories, Inc. ("UL") has not tested the performance or reliability of the security or signaling aspects of this product. UL has only tested for fire, shock and/or casualty hazards as outlined in UL's UL508, UL1203, UL 913, and CSA Standards for Safety. UL Certification does not cover the performance or reliability of the security or signaling aspects of this product.

UL MAKES NO REPRESENTATIONS, WARRANTIES OR CERTIFICATIONS WHATSOEVER REGARDING THE PERFORMANCE OR RELIABILITY OF ANY SECURITY OR SIGNALING RELATED FUNCTIONS OF THIS PRODUCT.

THIS PRODUCT IS USED IN AN ATEX/IECEx CERTIFIED ASSEMBLY. ANY CHANGES MADE TO THIS DRAWING MUST BE APPROVED BY UNDERWRITERS LABORATORY.

ATEX CERTIFICATE NUMBER: UL 24 ATEX 3256X

IECEx CERTIFICATE NUMBER: IECEx UL 24.0057X

Table of Contents

Warning Symbols	3
Receipt & Inspection	4
Notice	4
Introduction	5
System Specifications	6
Dimensions	7
Specific Conditions of Use	8
Tools Required / Mounting Instructions	8
Gland Entries / Blanking Elements	9
Front Cover Closure / Bolt Replacement	10
ESD Protection	11
Electrical Introduction / Equipment Grounding	12
Internal Connections	13
Cable Selection	14
External Connections	15
Terminal Board Connections	16
Terminal Board Connections (I.S.)	17
Communication	18
Battery Replacement	19
Replacement Front Cover Instructions	20
Bill of Material Metric ATEX/IECEX	21
Bill of Material NPT C1D1	22
Appendix A—Relay Contact Ratings	23
Appendix B—Input and Output Parameters	24
Appendix B—Input and Output Parameters (continued)	25
Appendix B—Input and Output Parameters (continued)	26
Notes	27
Warranty	28

Warning Symbols



CAUTION

Follow the warning instructions within the following information to avoid equipment failure, personal injury or death.



TURN POWER OFF

Before performing any maintenance, be sure to turn system power off to avoid any potential electric spark



FLAMMABLE

Flammable liquids and their vapors may cause a fire or explosion if ignited.



EYE PROTECTION

Pressurized systems may cause hazardous leaks and spray that may be dangerous for your eyes. Always wear eye protection around pressurized systems and its hazardous liquids.



INJURY

Wear gloves for protection from hazardous liquids that may cause irritation or burns.

READ

Read and understand all related manuals thoroughly. The Engineering and OIM manuals will provide the knowledge for all systems, maintenance and operation procedures. If you have any questions, please consult the factory.

Receipt & Inspection

Upon receipt of register shipment, be sure to inspect the packaging and the register assembly for any damage before signing the receipt of the shipment. Notify the delivery company about possible damage and refuse receipt of the shipment.

Registers are individually boxed and are protected with static resistant packing material. Each package is identified with the register assembly part number, description and serial number. Verify the register model is the correct model, size, and configuration as ordered. Contact your distributor if there is any discrepancy or question.

Register assemblies should be handled with appropriate methods for the size and weight involved. Appropriate clothing and shoes need to be utilized. Transport the register package to the installation site with appropriate transportation methods, careful not to damage the register.

Be careful of any loose or protruding staples from the packaging, as they can be very sharp and may potentially cause injury.

If foam has been used to protect register, carefully remove top foam layer before attempting to remove register assembly from box. Foam packaging maybe formed around the register assembly making it difficult to remove. Do not lift the register assembly by wires or anything other than the metal body of the register. Do not insert objects or cables into the register unless stated. Removing register assembly from packaging without adhering to these warnings may cause serious injury to you and/or the register.

Appropriate precautions should be taken regarding any personal, environmental and material compatibility with the end use system.

Notice

Total Control Systems (TCS) shall not be liable for technical or editorial errors in this manual or omissions from this manual. TCS makes no warranties, express or implied, including the implied warranties of merchantability and fitness for a particular purpose with respect to this manual and, in no event, shall TCS be liable for special or consequential damages including, but not limited to, loss of production, loss of profits, etc.

The contents of this publication are presented for informational purposes only, and while every effort has been made to ensure their accuracy, they are not to be construed as warranties or guarantees, expressed or implied, regarding the products or services described herein or their use or applicability. We reserve the right to modify or improve the designs or specifications of such products at any time.

TCS does not assume responsibility for the selection, use or maintenance of any product. Responsibility for proper selection, use and maintenance of any TCS product remains solely with the purchaser and end-user.

All rights reserved. No part of this work may be reproduced or copied in any form or by any means – graphic, electronic or mechanical – without first receiving the written permission of Total Control Systems, Fort Wayne, Indiana USA.

Introduction

The TCS 3000ex register is a fully integrated custody transfer flow computer that will control all vehicle delivery operations. The Open Software Architecture provides the option of a simple “*Pump & Print*” delivery or a custom measurement solution. The TCS 3000ex features a 7” x 3.5” full color VGA display screen, multiple delivery screens and a backlit alpha-numeric keypad for the user interface. As a flow computer with open software architecture, there will always be a need to add features to the register as the industry applications evolve. Therefore, please be reminded to contact the factory for periodic updates.

The TCS 3000ex electronic register is a fully integrated flow computer that will control all delivery operations. The modular design and open software architecture provide you with a tailored system that is expandable for future needs. The TCS 3000ex features a large easy view VGA screen, alpha-numeric keypad and open printer interface for simple “*Pump and Print*” deliveries. Software features offer complete flexibility of delivery screen information with preset, price/tax, customizable ticket format and password protection.

The TCS 3000ex improves your product security and eases access to your delivery data and reduce your operation costs. Many additional features are available (multiple product delivery, additive injection, density/temperature correction, multiple valve & pump control, etc.) to enhance your measurement solution.

This manual will help guide you with the setup confirmation and calibration of the register. Additional information will be provided for wiring instruction and auxiliary devices to integrate into the register.

Product Nameplates

ATEX / IECEx

 The Standard of Measurement 2515 Charleston Place Fort Wayne, IN 46808 “Made in the U.S.A.”	MODEL	TCS 3000EX	IP66, -40°C ≤ Tamb ≤ +60°C, PULSE INPUT SIGNAL: 0-5000 Hz	WARNING: DO NOT OPEN WHEN EXPLOSIVE ATMOSPHERE IS PRESENT. WARNING: CONDUIT SEAL MUST BE INSTALLED WITHIN 20MM.
	MFG. DATE		9 ENTRIES, M20X1.5, BATTERY: RENATA CR2477N	
	VERSION		OIML TC 8392	
	SERIAL	XXXXXX	ATEX CERT. No.: UL 24 ATEX 3256X	
	INPUT	10-30 VDC, 33W	IECEx CERT. No.: IECEx UL 24.0057X	
			  0539 II 2 (2) G Ex db ib [ib] IIB T4 Gb	

UL

 The Standard of Measurement 2515 Charleston Place Fort Wayne, IN 46808 “Made in the U.S.A.”	MODEL	TCS 3000EX	BATTERY: RENATA CR2477N	 LISTED TELEMETERING EQUIPMENT FOR USE IN HAZARDOUS LOCATIONS 3YC9
	MFG. DATE		-40°C ≤ Tamb ≤ +60°C	
	VERSION		ENCL TYPE: TYPE 4X IP66	
	SERIAL	XXXXXX	PULSE INPUT SIGNAL: 0-5000 Hz	
	INPUT	10-30 VDC, 33W	CLASS I, DIV. 1, GROUPS C & D, T4	
			REFER TO INSTALLATION MANUAL TCS 900342 REV. 2 INTRINSICALLY SAFE WITH I.S. OUTPUTS INTRINSEQUEMENT SUR AVEC I.S. RESULTATS	

WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY. AVERTISSEMENT : LA SUBSTITUTION DE COMPOSANTS PEUT ALTÉRER LA SÉCURITÉ INTRINSÈQUE.

CAUTION: TO REDUCE THE RISK OF IGNITION OF HAZARDOUS ATMOSPHERES, DISCONNECT THE EQUIPMENT FROM THE SUPPLY CIRCUIT BEFORE OPENING. KEEP ASSEMBLY TIGHTLY CLOSED WHEN IN OPERATION. WARNING: IGNITION CAPABLE BATTERY INSIDE. DO NOT OPEN WHEN IGNITABLE ATMOSPHERE IS PRESENT. KEEP ASSEMBLY TIGHTLY CLOSED WHEN IN OPERATION. WARNING TO REDUCE THE RISK OF IGNITION OF HAZARDOUS ATMOSPHERES, CONDUIT RUNS MUST HAVE A SEALING FITTING CONNECTED WITHIN 18 INCHES OF THE ENCLOSURE.

ATTENTION : POUR RÉDUIRE LE RISQUE D'INFLAMMATION D'ATMOSPHÈRES DANGEREUSES, DÉBRANCHEZ L'ÉQUIPEMENT DE L'ALIMENTATION CIRCUIT AVANT OUVERTURE. GARDER L'ASSEMBLAGE BIEN FERMÉ LORS DU FONCTIONNEMENT. AVERTISSEMENT : BATTERIE CAPABLE D'ALLUMAGE À L'INTÉRIEUR. NE PAS OUVRIR LORSQUE UNE ATMOSPHÈRE INFLAMMABLE EST PRÉSENTE. GARDER L'ASSEMBLAGE BIEN FERMÉ LORS DU FONCTIONNEMENT. AVERTISSEMENT POUR RÉDUIRE LE RISQUE D'INFLAMMATION D'ATMOSPHÈRES DANGEREUSES, LES CONDUITS DOIVENT AVOIR UN RACCORD D'ÉTANCHÉITÉ CONNECTÉ À 18 POUCES DE L'ENCEINTE.

System Specifications

ELECTRICAL

Supply Voltage	DC Version: 10 to 30vdc
Power Consumption	33W (maximum)
Maximum Input Current	3.3A
Relay Outputs	7 relays, single contact, Normally Open (NO) 1 optical relay, single port, Normally Open (NO) Please refer to Appendix A—"Relay contact ratings" for limiting values on the relay contacts
Type	Single or Dual Channel
Power	5vdc or 12vdc

ENCLOSURE

Aluminum sand cast with epoxy powder coat	
Ratings	IECEx and ATEX Class I Zone 1, Group IIB, T4 UL/cUL Class 1 Division 1, Group C and D Hazardous Locations
Temperature Range	- 40 F to 140 F (-40 C to 60 C)
Connection Ports:	Nine (9) M20 (ATEX only) threaded connection ports Optional Nine (9) 1/2" NPT (UL/cUL only) threaded connection ports
Calibration Seal	Hall effect switch, password and mechanical seal

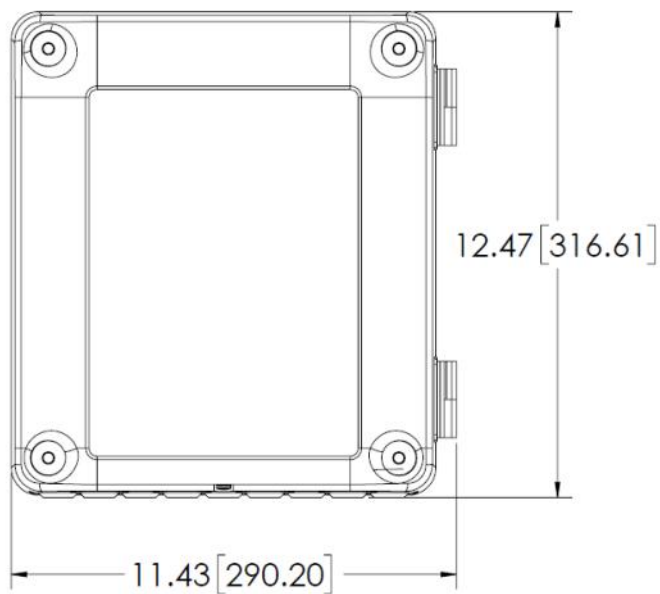
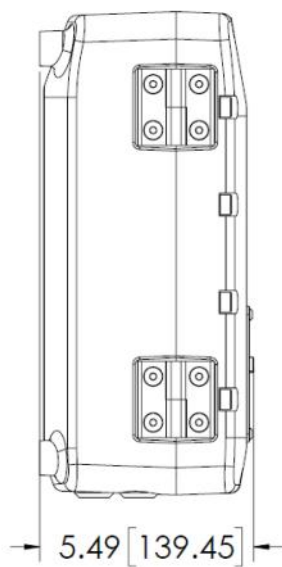
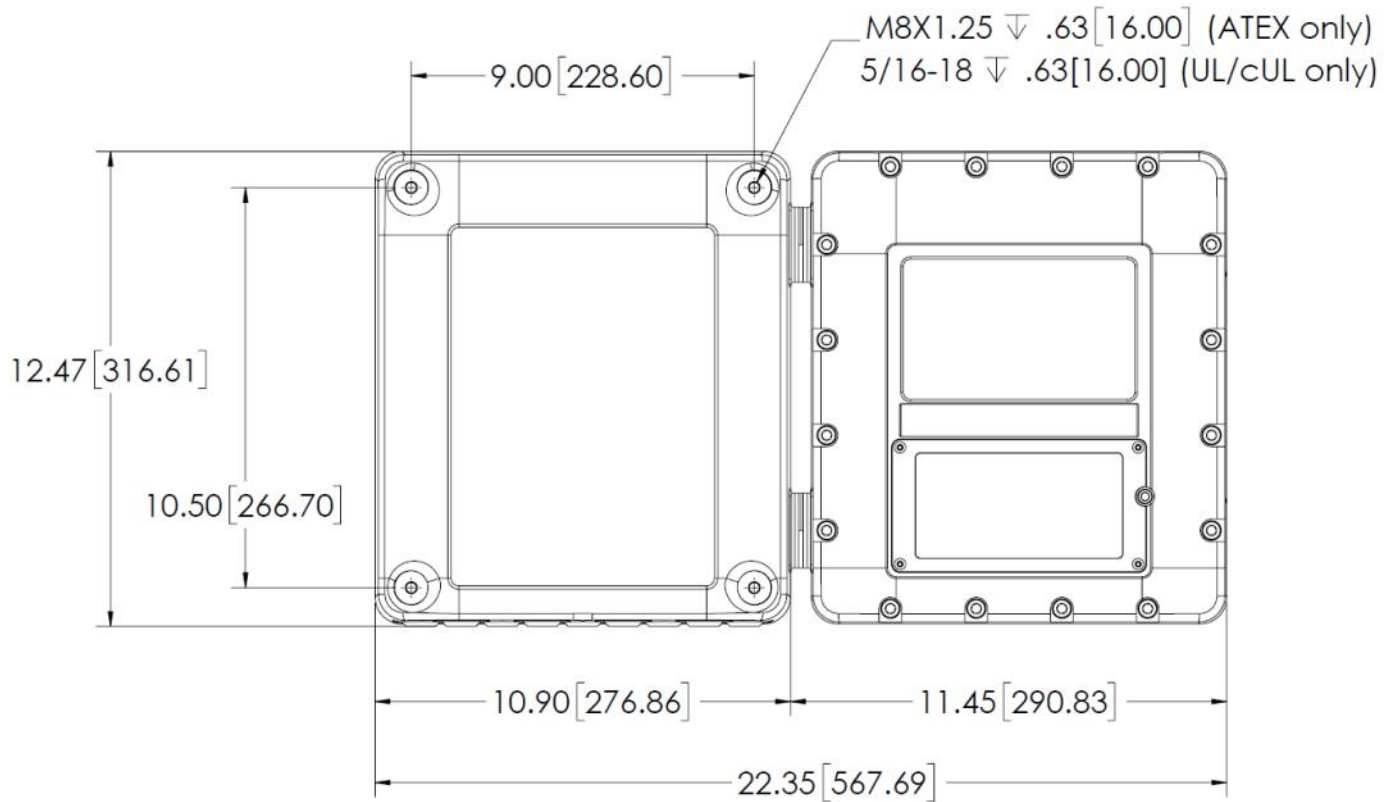
The USB0 and USB1 ports are for maintenance only. To access these connectors, power to the unit must be disconnected and the area known to be free of ignitable gas or equivalent.

COMMUNICATION

Two (2) RS 485, plus (1) internal RS485, 2-wire half duplex, custom protocol; 9600 baud, 8 bit, no parity, 1 stop bit
Two (2) RS 232 output, 3-wire; 9600 baud; 8 bit, no parity, 1 stop bit

Dimensions

INCHES (MILLIMETERS)



Installation

SPECIFIC CONDITIONS OF USE

- Do not repair flameproof joints.
- The TCS 3000ex is to be mounted vertically (i.e., M20 x 1.5 mm entries facing down) only.
- Use only M8 X 1.25MM socket head cap fasteners with yield stress ≥ 31200 psi (215116.4 Kpa)

TOOLS REQUIRED

Installation:

- 10mm hex wrench required for tightening blanking elements

Servicing and Repair:

- #2 Philips screwdriver
- 6mm Hex Allen wrench
- T15 Torx wrench

MOUNTING TCS 3000ex ENCLOSURE

Exterior dimensions of the standard TCS 3000ex enclosure are shown Page 6. There is only one mounting orientation possible. The TCS 3000ex is to be mounted vertically (gland entries facing down) only.

Cable entries are located at the bottom of the unit. The enclosure cover is secured to the housing by (16) 8mm socket cap bolts. A 6mm Allen head wrench is required to remove the bolts. When the bolts are removed, the front cover will swing left and hang from its hinges.

Mounting Fasteners:

Fasteners must be selected to support the minimum weight of 40 lbs (18.14 kg).

Mounting suggestions include:

Metal Plate or Rail: Use four M8 hex head or socket head cap screws.

Gland Entries

BLANKING ELEMENTS

The TCS 3000ex is supplied with 9 flameproof “db” blanking elements. These blanking elements utilized an o-ring seal that must be maintained in order to maintain IP66 on the device. Blanking element should be installed hand tight, visual inspection of the o-ring to ensure proper seating, then tightened a further 1/4 to 1 full turn making them tool secure (5Nm). Care must be taken when installing the blanking element as to not pinch or damage the o-ring prior to final torque.



WARNING: If there are unused holes, blanking elements satisfying the flameproof “db” method of protection must be used. Blanking elements must be removable with the aid of a tool, IECEx and ATEX certified, suitable for at least Group IIB and suitable for an ambient temperature range of -40 C to +60 C. Blanking elements shall not be used with a thread adaptor.

CABLE GLAND ENTRIES

There are either nine (9) M20 x 1.5mm holes (ATEX only) or nine (9) 1/2” NPT (UL/cUL only) holes in the enclosure bottom are provided for the installation of cable glands. A gland with the correct corresponding thread must be installed in the opening. A minimum thread engagement of 8 full threads is required. The selection and usage of suitable -rated cable glands shall be determined by the end user during the installation process and shall be installed in accordance with suitable wiring methods and local regulations.



The TCS 3000ex utilizes a special enclosure in order to prevent spark and thermal ignition of the external Explosive Atmosphere. The enclosure is UL certified according to IECEx and ATEX Certified per IEC/EN 60079-0, -1, and -11. The enclosure protection level (EPL) is Gb according to IEC 60079-0. The ingress protection level is IP66.

All cables are fed into the enclosure through special Gb- certified cable glands, which prevent ignition of the external explosive atmosphere.

***Note:** As the TCS 3000ex provides either nine (9) M20 x 1.5mm holes (ATEX only) or nine (9) 1/2” NPT (UL/cUL only) , in systems which use larger number of external devices, it may be necessary to add an external connection panel in protected box in order to be able to route all connections.

Front Cover

COVER CLOSURE AND BOLT REPLACEMENT

When closing the cover gently lift on the bottom of the cover when in position for starting one or two of the right corner bolts. This is done to assist in alignment of the cover and base holes to starting the bolts. Reference the details below. NOTE: The drilled socket screw should be used in location 5 to allow for a sealing wire to be used.

Cover Bolts

16 Socket Head, M8 x 1.25 x 45 mm length, Stainless Steel

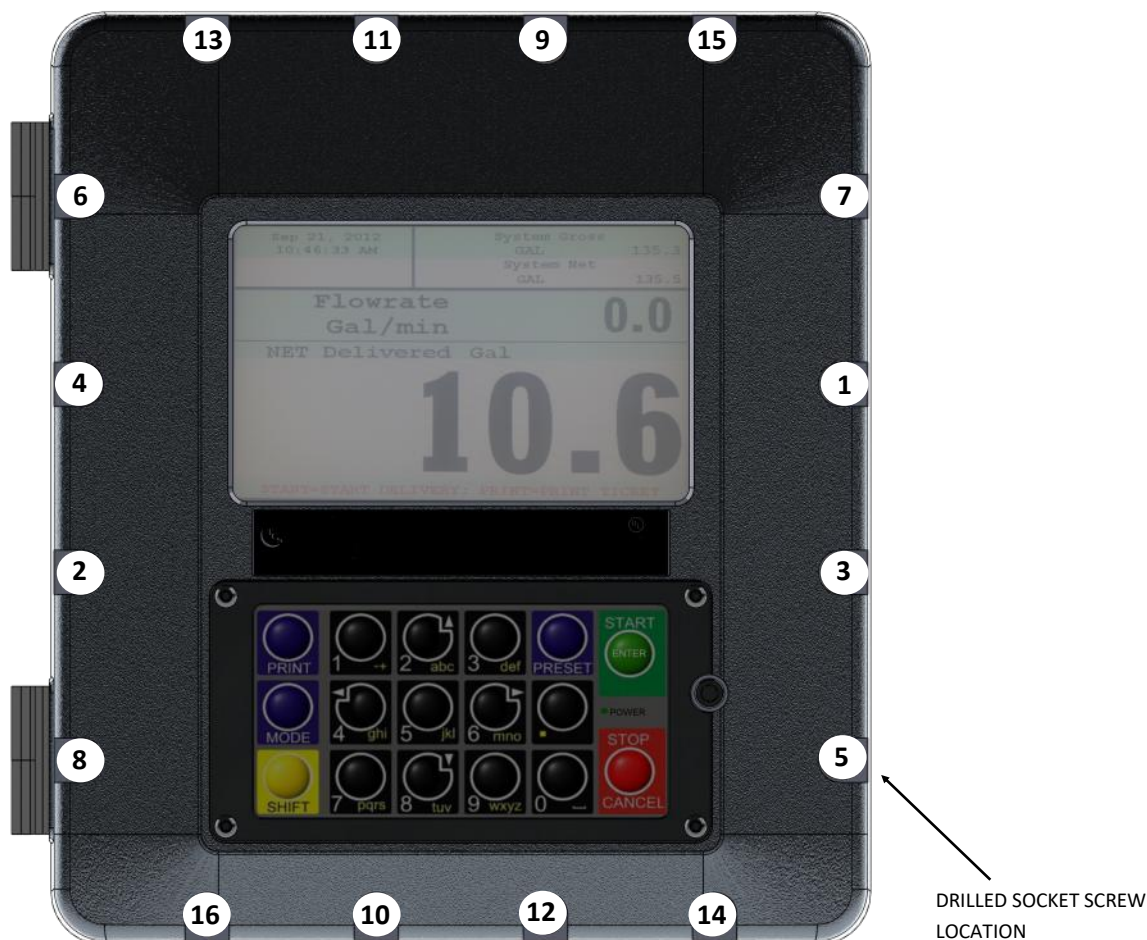
Torque Recommendations:

164 Inch-Pounds (18.5 Newton-Meters) Dry stainless steel fasteners can gall/seize in aluminum. Use a thread lubricant (petrolatum or similar). Torque Sequence Found below.

Flange Protection

Be sure to keep the flanges clean and free of scratches and nicks so as not to compromise the quenching ability of the flame path. All cover bolts must be tightened for maintaining the explosion proof capability of the enclosure.

Recommended Torque Sequence

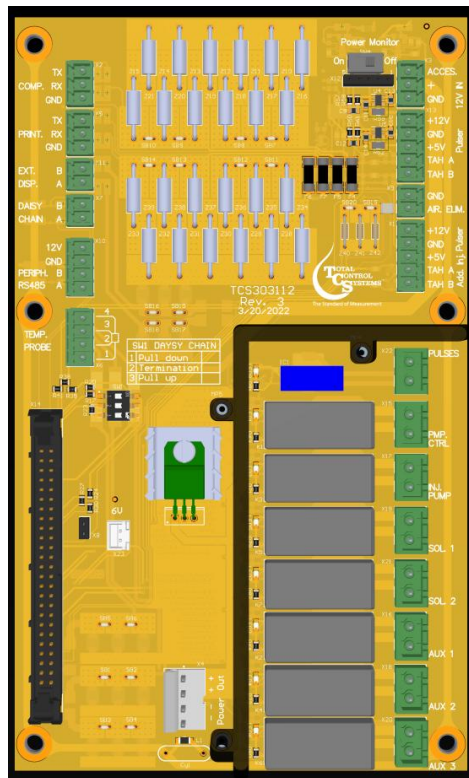
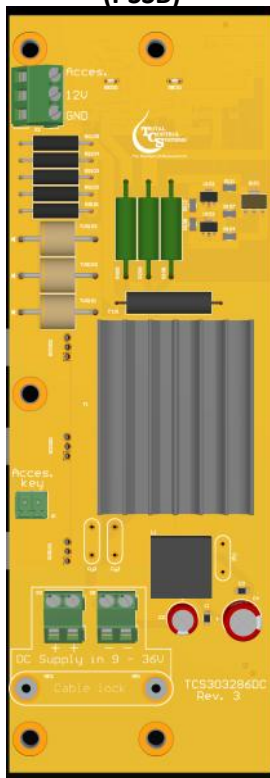


Installation

Electrostatic Discharge (ESD) Protection

The TCS 3000ex contains electronic components and assemblies subject to damage by ESD. The TCS 3000ex was designed to protect against ESD while the unit is closed and in normal operation. Proper handling procedures must be observed during the removal, installation, repair and other handling of printed circuit board assemblies, electronic devices and components to include:

1. Service to be performed by authorized personnel only.
2. The person performing the service must be grounded by an ESD grounding strap and connected to ground.
3. While performing maintenance or repair, touch an unpainted metal area of the TCS 3000ex surface prior to touching or handling any printed circuit boards or electronic components.
4. Printed circuit board assemblies must be placed in and transported in a conductive bag or other conductive container.
5. Printed circuit boards must not be removed from the conductive container until time of use.
6. All other “best” practices for protecting devices from ESD must be observed.

Terminal Board (TB)**Power Supply Stabilization Board****(PSSB)****Electrical****EQUIPMENT GROUNDING**

External Grounding
Screw (10-32)

#10 Internal
Lock washer



To reduce the risk of ignition in hazardous atmospheres, conduit runs must have seals installed within 18 inches (45 cm) of the enclosure.



For ambient temperatures below -10°C and above +70°C, use field wiring suitable for both minimum and maximum ambient temperature.



To reduce the risk of ignition in hazardous atmospheres, conduit runs must not be more than the size of the conduit or 50mm, whichever is the lesser.



Circuits must be limited to overvoltage category I/II as defined in IEC 60664-1.

EQUIPMENT GROUNDING

The IEC/EN 60079 series of electrical safety standards for hazardous locations also requires an external ground for DC operation. Do not use external ground for North American Installations.

The wire connection is on the bottom middle exterior surface (near the conduit entries). The following wire sizes may be used: 10 AWG (5.26 mm²) or 11 AWG (4.17 mm²). Lock washer must be used to mitigate any twisting and loosening.



Do not connect the power supply dc common to earth ground.

The resistance between the earth ground terminal on the TCS 3000ex and the ground point must not exceed 3 ohms. The recommended ground point is a copper grounding rod (minimum ½" (12.7 mm) diameter) that reaches into the water table, or similar certified grounding point. Conduit, piping, structural and structural steel are not to be used for

Electrical



All external connections to the TCS 3000ex system (power and peripheral connections) are located on two printed circuit boards mounted in the back part of TCS 3000ex enclosure – “Power Supply Stabilization Board” (PSSB) and “Terminal Board” (TB)

All wiring must enter the TCS 3000ex enclosure through conduit via entries in the bottom of the enclosure. All conduit must be terminated at the enclosure by use of appropriately rated conduit hubs or glands.

Wiring must comply with all local electrical codes.

Installation of the TCS 3000ex must comply with NEC/CEC and any local codes for US/Canada.

Do not allow service loop cables to overlap the circuit boards. Coil any cable length in the bottom of the enclosure. Separate cables by 3” (76.2 mm) or more.

DC POWER

The TCS 3000ex can have a 24Vdc power supply. The DC power supply should be protected by a 4 Amp fuse.

Power required: 10 – 36Vdc, 33W maximum.

The 2 position terminal block is located in the lower left hand corner of the PSSB board.

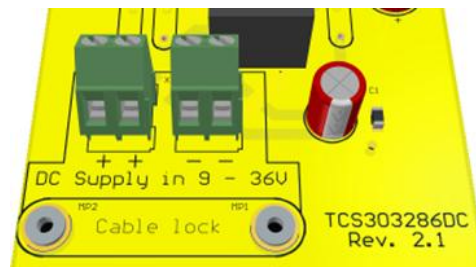
Wires must be stripped ¼” and inserted into the DC Supply in terminal block leaving no bare conductor exposed.

The DC version of the TCS 3000ex allows for use of 4 wire double connection to the main DC power (2 x Positive and 2 x Negative) with maximum wire size: **14 AWG(2.5mm²), shielded.**

When selecting the wire size – consider that the **maximum input current is 3.9A** and the total cable run length. Depending on the required wire cross-section and redundancy requirements select single or double wiring.

General wire guidelines for using 24 Vdc power supply. Note: Voltage at the input terminal should be measured at 24VDC minimum.

<u>Wire gauge (AWG)</u>	<u>Distance (feet)</u>
24	50
22	100
20	150
18	250
16	400



DC POWER CABLE INSTALLATION

If the installation is using separate external grounding wire it can also be connected to the outside of the enclosure. Measure the conductor lengths according to the instructions for cable selection on page 12. The DC input is located on the lower part of the DC PSSB (on the right side of the enclosure). Strip the ends of the 4 conductors and crimp ferules with insulation sleeves (corresponding to the selected wire cross-section) to them. Insert all 4 conductors (with their ferules) in their corresponding places in the input connector of the PSSB and secure the connector screws using torque of 3.5 lbf.in (0.4 Nm). Place the cable lock over the 4 conductors of the input connector and make sure that there is sufficient slack allowing for the cable lock to be locked without stressing the input connector. Tighten the cable lock over the conductors.

Cable Selection



CABLE SELECTION

When selecting cables, the following requirements have to be fulfilled:

- The outer diameter of the cables must be suitable for the cable glands selected.
- The cable must have continuous operation temperature range (under full load) of at least **-40°F to 158°F (-40°C to +70°C)**.
- The cable must comply with the requirements for installation in intrinsically safe systems in explosive atmosphere
- UL: Class I, Division 1; Certified according to UL2225:2013 (Edition 4) – for example TC-ER-HL type of cable.
- ATEX: Zone 1 IIB; Certified according to IEC 60079-14:2013 (Edition 5) – for example HELUCABLE OZ-BL-CY.

MINIMUM CABLE LENGTH



In order for the cables to be compliant with the ATEX requirements of IEC 60079-14 they need to have minimum length of 3m (10ft). All cables in the installation must be protected from damage by location or a suitable guard. The conditions of maintenance and supervision must ensure that only qualified persons service the installation.

CABLE SHIELDS



The TCS 3000ex connects all cable shields to the body of the enclosure through the cable glands. When using shielded cables, the shield must be either braid or serve type in order to ensure proper connection to the connection sleeve inside the cable glands. Cables using foil or tape type shields cannot be used.

CABLE SHIELD CONNECTIONS

When using shielded cables for data communications and pulser connections, make sure that the cable shield is connected to a connection on a body of a device only on one end of the cable. This recommendation does not apply to low-speed signals and power carrying cables such as the main power cable, solenoid cables etc.—for those connections the shield should be connected at both ends.

External Connections



GENERAL DESCRIPTION

All main connections to external devices are located on the Terminal Board (TB). All connections to the terminal board are realized through plug connectors for ease of assembly. When connecting external devices verify that they comply with the load ratings listed in appendixes A and B of this manual. Include cable capacitance and inductance when calculating the total loading values for I.S. circuits.

Note: The TCS 3000ex controls all solenoids through relay contacts only. The user needs to provide external power for the solenoids. The maximum short circuit current (in case of solenoid failure) must be limited in accordance with Appendix A.

The output current of this associated apparatus is limited by a resistor such that the output voltage-current plot is a straight line drawn between open-circuit voltage and short-circuit current.

TABLE 1:

<u>I.S. Equipment</u>		<u>Associated Apparatus</u>
V_{max} (or U_i)	$\geq$	V_{oc} or V_t (or U_o)
I_{max} (or I_i)	$\geq$	I_{sc} or I_t (or I_o)
P_{max} , P_i	$\geq$	P_o
$C_i + C_{cable}$	$\leq$	C_a (or C_o)
$L_i + L_{cable}$	$\leq$	L_a (or L_o)

Selected intrinsically safe equipment must be third party listed as intrinsically safe for the application, and have intrinsically safe entity parameters conforming with Table 1 below.

This associated apparatus may also be connected to simple apparatus as defined in Article 504.2 and installed and temperature classified in accordance with Article 504.10(D) of the National Electrical Code (ANSI/NFPA 70), or other local codes, as applicable.

Capacitance and inductance of the field wiring from the intrinsically safe equipment to the associated apparatus shall be calculated and must be included in the system calculations as shown in Table 1. Cable capacitance, C_{cable} , plus intrinsically safe equipment capacitance, C_i must be less than the marked capacitance, C_a (or C_o), shown on any associated apparatus used. The same applies for inductance (L_{cable} , L_i and L_a or L_o , respectively). Where the cable capacitance and inductance per foot are not known, the following values shall be used for two or three core cables: $C_{cable} = 60\text{pF/ft.}$, $L_{cable} = 0.2\text{ }\mu\text{H/ft.}$

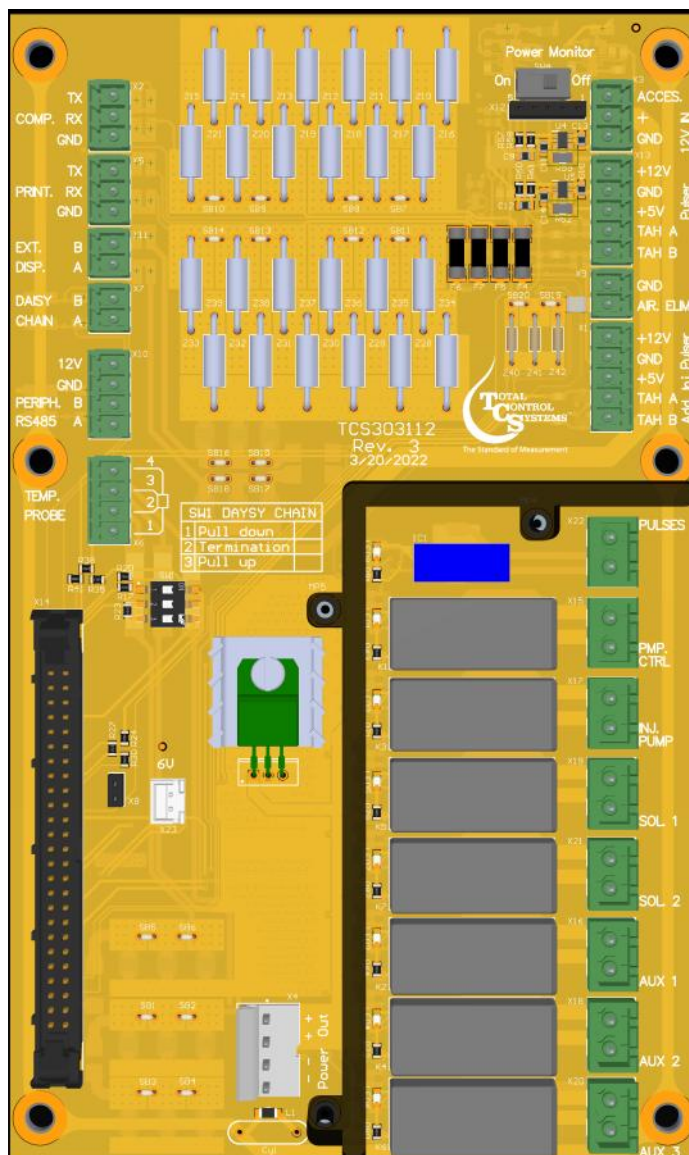
Associated apparatus must be installed in an enclosure suitable for the application in accordance with the National Electrical Code (ANSI/NFPA 70) for installation in the United States, the Canadian Electrical Code for installations in Canada, or other local codes, as applicable.

The associated apparatus must be connected to a suitable ground electrode per the National Electrical Code (ANSI/NFPA 70), the Canadian Electrical Code or other local installation codes, as applicable. The resistance of the ground path must be less than 1 ohm.

Where multiple circuits extend from the same piece of associated apparatus, they must be installed in separate cables or in one cable having suitable insulation. Refer to Article 504.30(B) of the National Electrical Code (ANSI/NFPA 70) and Instrument Society of America Recommended Practice ISA RP12.06 for installing intrinsically safe equipment

This associated apparatus has not been evaluated for use in combination with another associated apparatus.

Terminal Board Connections



INTERNAL CONNECTION

MAIN PULSER "db"

MAIN PULSER POWER

MAIN PULSER INPUTS

AIR ELIMINATOR INPUT "db"

MAIN PULSER "db"

ADD. INJ PULSER POWER

ADD INJ. PULSER INPUTS

+ PULSE OUT

-

OPEN OPTICAL RELAY OUT

PUMP CONTROL (X15)

OPEN DRY RELAY CONTACT

ADDITIVE INJECTOR PUMP/ PUMP SPEED CONTROL 1 (X17)

OPEN DRY RELAY CONTACT

SOLENOID 1 (S1 STAGE) (X19)

OPEN DRY RELAY CONTACT

SOLENOID 2 (S2 STAGE) (x21)

OPEN DRY RELAY CONTACT

AUX 1 PULSE OUT RESET/ PUMP SPEED CONTROL 2 (X16)

OPEN DRY RELAY CONTACT

AUX 2 AIR ELIMNATOR VALVE (X18)

OPEN DRY RELAY CONTACT

AUX 3 ADDITIVE INJECTOR VALVE (X20)

OPEN DRY RELAY CONTACT

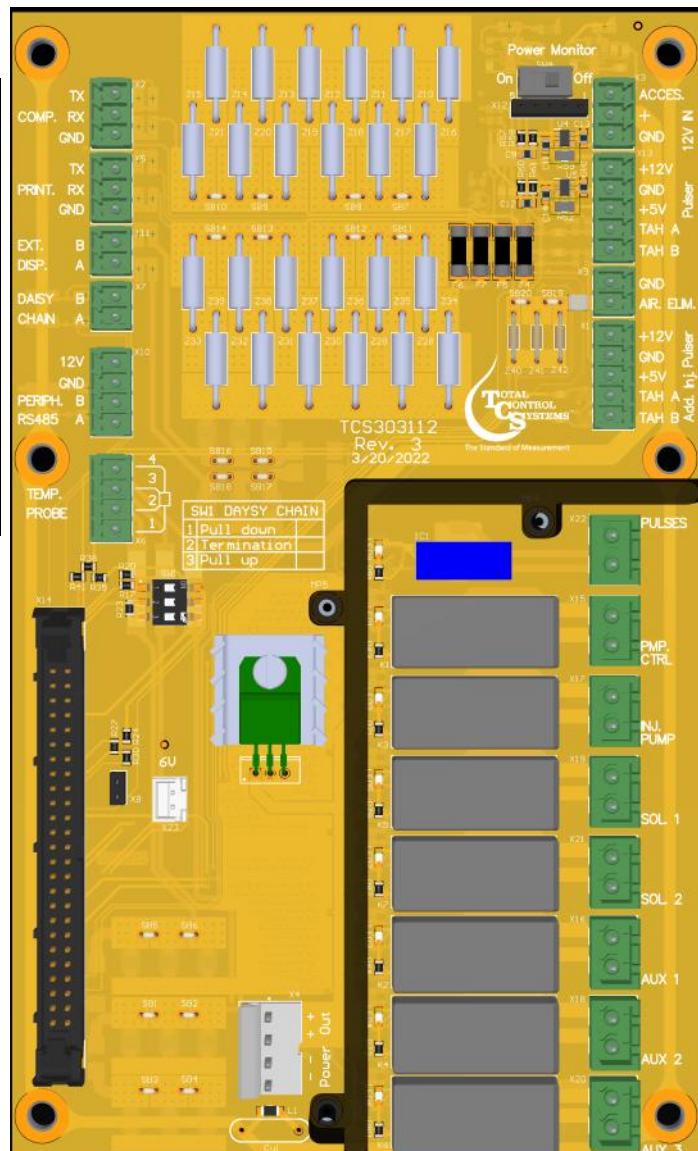
Terminal Board Connections



INTRINSICALLY SAFE CONNECTIONS (Marked in Green)

All intrinsically safe (I.S.) field wiring to the TCS 3000ex must be in accordance with article 504 of the NEC for installations in US/Canada. Intrinsically safe circuits must be wired and separated in accordance with Article 504.20 of the National Electrical Code (ANSI/NFPA 70) or other local codes, as applicable.

(I.S.)	RS 232 PC CONNECTION
(I.S.)	RS 232 PRINTER
(I.S.)	RS 485 EXTERNAL DISPLAY
"db—db"	RS485 DAISY CHAIN
INTERNAL CONNECTION	RS485 PERIPHERAL INTERFACE
(I.S.)	TEMPERATURE PROBE



Communication



COMMUNICATION

The TCS 3000ex has five communication ports each with a specific purpose. The following section provides the information required to select and make the wiring connection to the port.

"COMP"	RS-232	PC Connection
"PRINT"	RS-232	Printer
"EXT. DISP."	RS-485	External Display
"DAISY CHAIN"	RS-485	Communication between two or more TCS 3000ex devices
"PERPH. RS-485"	RS-485	RS-485 PERIPHERAL INTERFACE

RS-485 communications protocol is designed for multi-point (i.e. computer to multiple devices, also called multi-dropped) communications up to 4,000 feet (1,220 Meters). A ground wire is not required, even though some devices may have a terminal block for a ground.

Wire used must meet the following minimum requirements:

- 24 AWG stranded.
- 2 conductor with overall shield (data only).
- 30 pF maximum between conductors.
- 1,000 ohm impedance.
- Maximum length: 4,000 feet (1,220 Meters)
- Maximum stub length: 15 feet.
- All exposed shields must be properly insulated to prevent short circuits.
- All shields must be continuous, soldered and properly insulated.
- Environment conditions should also be considered.

RS-232 protocol is designed for point-to-point (i.e., computer to a single device) communications limited to 50 feet requiring a minimum of 3 wires (transmit (TX), receive (RX) and ground (G)).

Wire used must meet the following minimum requirements:

- 24 AWG stranded.
- 3 conductor with overall shield (data only).
- 30 pF maximum between conductors.
- 1,000 ohm impedance.
- Maximum length: 4,000 feet (1,220 Meters)
- Maximum stub length: 15 feet.
- All exposed shields must be properly insulated to prevent short circuits.
- All shields must be continuous, soldered and properly insulated.
- Environment conditions should also be considered.

RTD Input

- "TEMP PROBE"
- 100-ohm platinum, four wire
- Coefficient 3850ppm/⁰C

Battery Replacement

Battery Specifications:

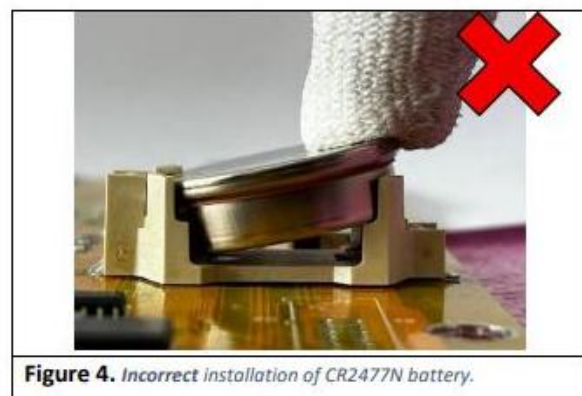
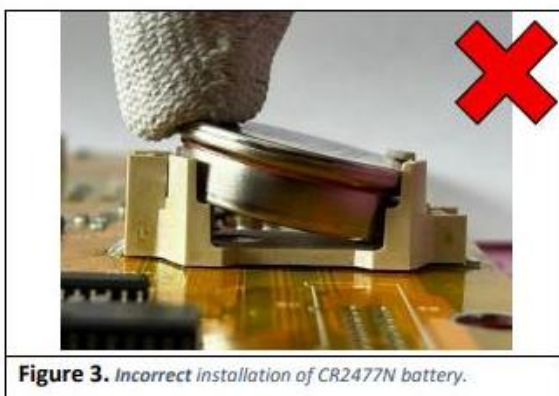
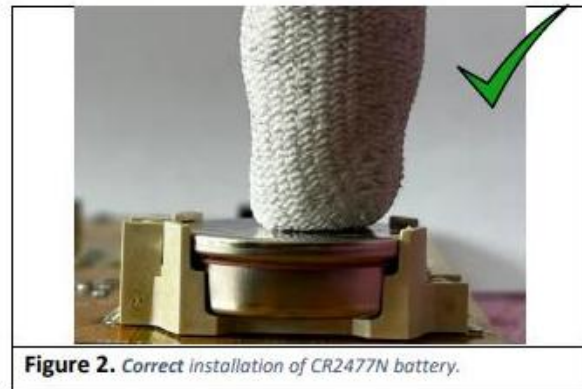
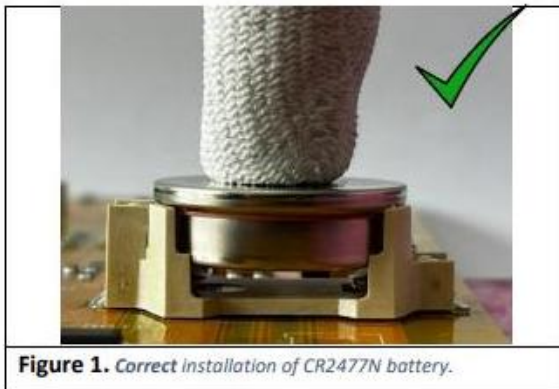
Manufacture: Renata

Manufacture Part Number: CR2477N

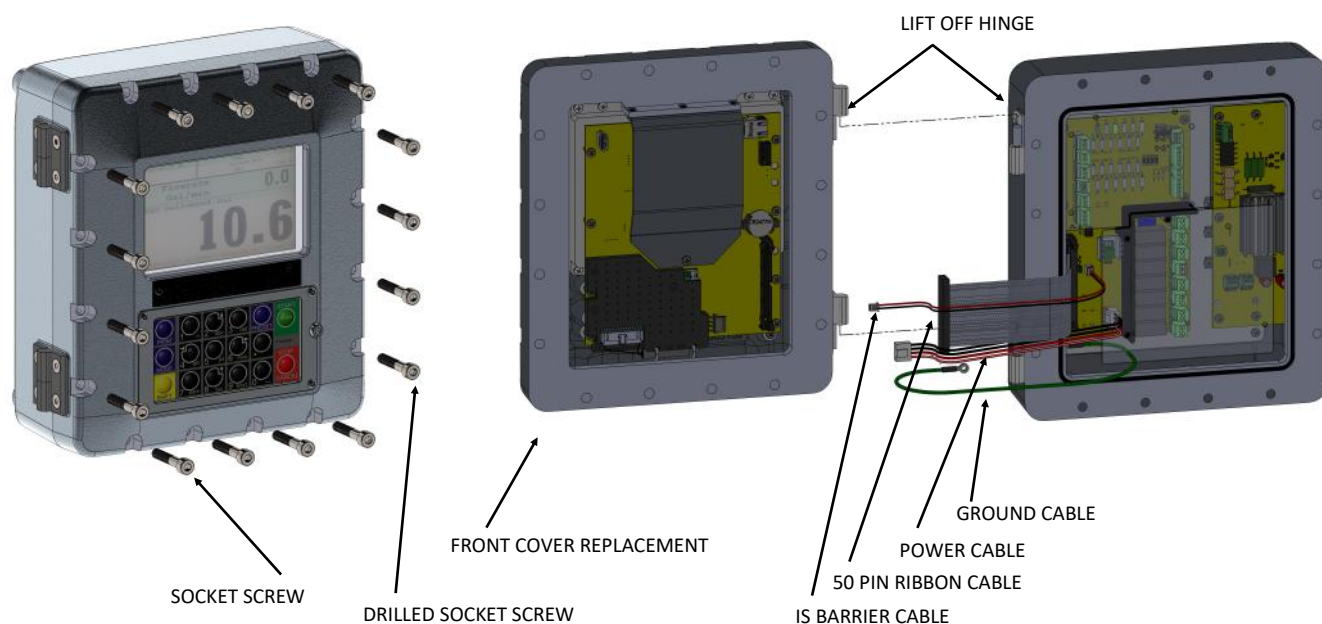
The TCS 3000ex is equipped with a replaceable battery which is not intended to be replaced when in an explosive atmosphere.

Replacement Procedure

1. Ensure no explosive atmosphere is present.
2. Ensure power is disconnected from the device prior to opening the device.
3. Remove 16—8mm mounting bolts (6mm Allen Wrench) from front cover, and open front cover. Take care to ensure that there is no damage to the joint surfaces during the replacement procedure.
4. Remove existing battery avoiding conductive surfaces which can cause the battery to short.
5. Place the battery with the correct polarity (+ and -) into the battery location into the socket horizontally, push it down in the slot while maintaining horizontal position until there is a click and the battery is locked from both sides. (Figures 1 and 2 below for the correct installation)
6. Before closing the device after replacement, make sure there is no damage to the seal or sealing surfaces of the enclosure and take care to insure that any cables are clear of the mating surfaces prior to closing the front door.
7. Once the door is close, reinstall the covers bolts following the steps for bolt torque on page 10.



Replacement Front Cover



REQUIRED TOOLS:

- 6 mm Allen Wrench
- Philips Screw Driver

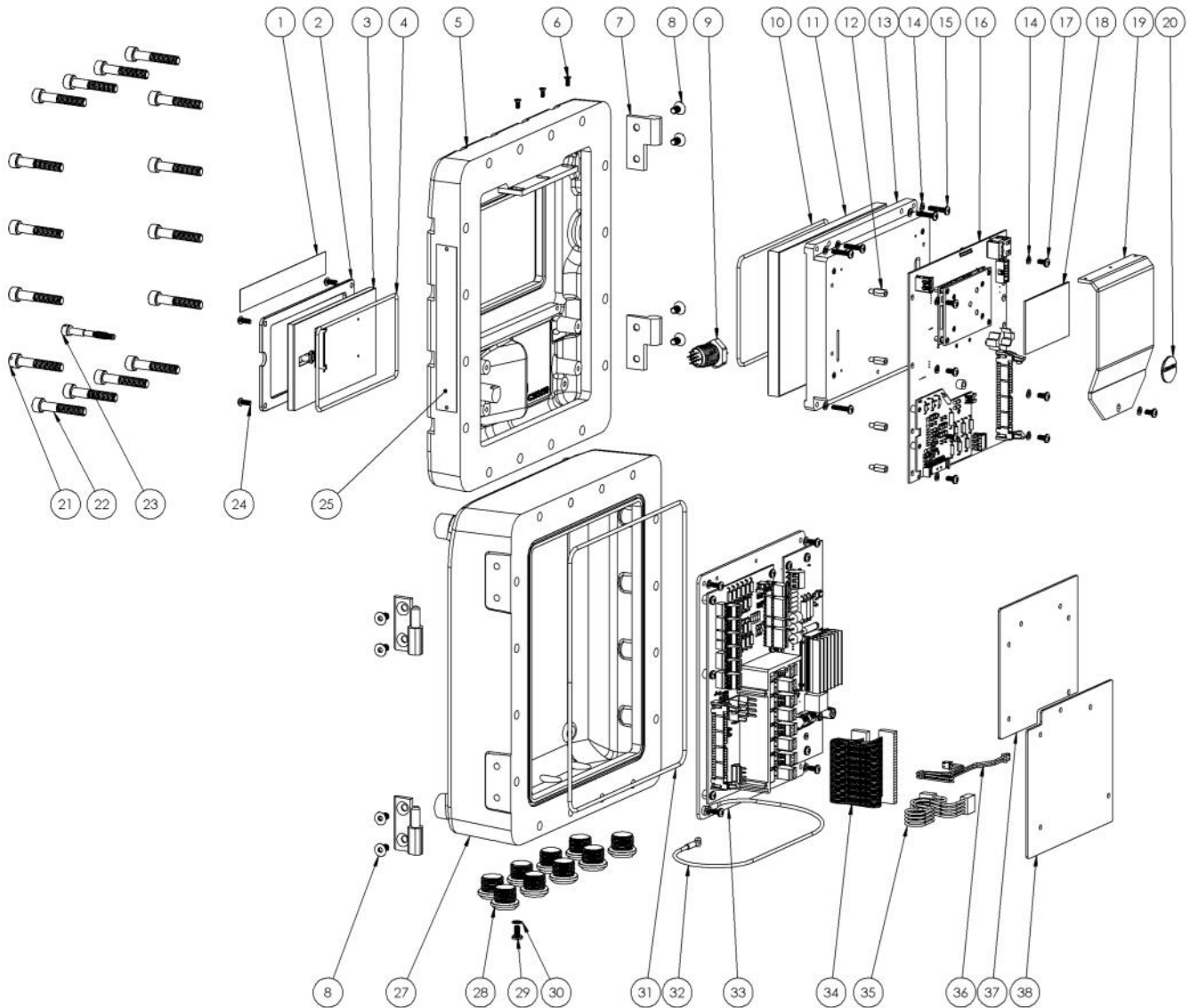
Installation Procedure

1. Remove 8mm mounting bolts (6mm Allen Wrench) from front cover, and open front cover.
2. Unlatch the 50 Pin Communication, Power, and IS Barrier cables from the front cover assembly.
3. Detach the grounding cable from the front cover assembly using a Philips screw driver.
4. Open the front cover all the way and lift off the front cover.
5. Once the replacement front cover computer is received, carefully remove the unit from the anti-static plastic bag and do not dispose of the original packaging materials.
6. Reassemble the replacement front cover computer assembly to the rear housing.
7. Insert the 50 Pin Communication, Power ribbon cable, IS barrier power cable, and fastening the grounding cable.
8. Reference page 10 for cover closure, bolt installation, and torque procedure.
9. Insert the original front cover assembly into the anti-static bag and carefully place back into the original box packaging.

NOTE: Packing instructions are within the original box.

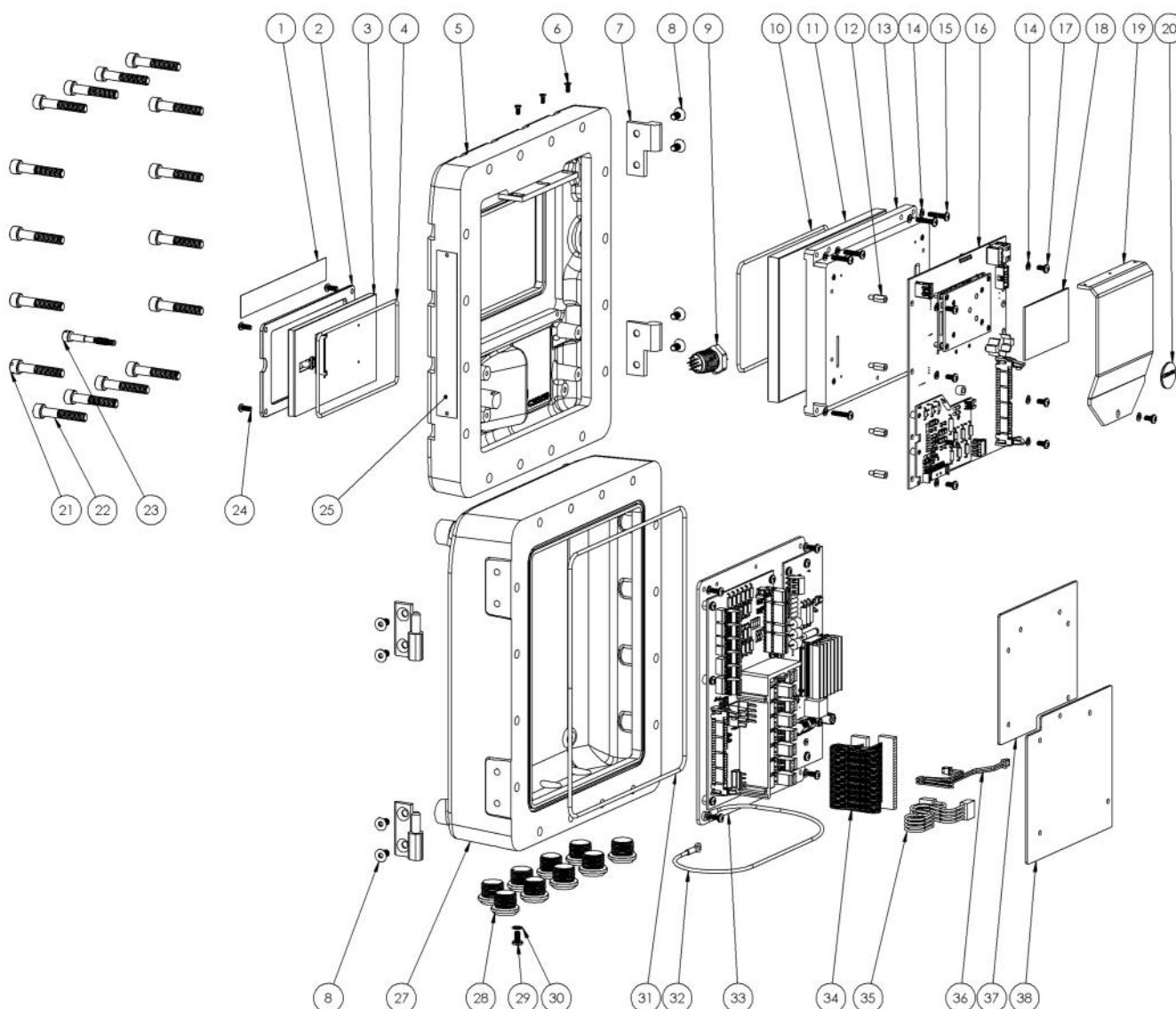
10. Before shipping back to Total Control Systems, be sure to have a Returns Goods Authorization enclosed within the packaging.

TCS 3000ex METRIC IECEx/ATEX Parts List



ITEM	PART NO.	DESCRIPTION	QTY.	ITEM	PART NO.	DESCRIPTION	QTY.
1	303011-1	ATEX NAMEPLATE, 3000EX	1	21	303171D	M8 X 45MM SOCKET CAP SCREW, 18-8 DRILLED	1
2	303131	KEYBOARD BEZEL	1	22	303171	M8 X 45MM SOCKET CAP SCREW, 18-8 SS	15
3	303230	KEYBOARD, 3000EX	1	23	303156R	CALIBRATION SCREW SOCKET CAP 18-8 SS, 3000EX	1
4	300144	KEYBOARD GASKET	1	24	303159	M4 X 8MM TORX HEAD SCREW, 18-8 SS	4
5	303150	FRONT COVER, 3000EX	1	25	NA	N/A	
6	300122	SKT CNTRSNG SCREW M3X8	3	26	303175	REAR HOUSING, 3000EX METRIC (IECEx/ATEX ONLY)	1
7	303172	HINGE B, 3000EX	2	27	303252	PLUG, M20 ATEX Ex db IIB Gb (IECEx/ATEX ONLY)	8
8	303173	M6 X 12MM FLAT HEAD HEX DRIVE, SS	8	28	790660	10-32 X 3/8 PAN HEAD SCREW, GREEN	1
9	303231	KEYBOARD CABLE, 3000EX	1	29	790676	10-32 INTERNAL TOOTH LOCKWASHER	1
10	303146	GASKET, 7" DISPLAY	1	30	303174	HOUSING ORING, 3000EX	1
11	303147	PROTECTIVE GLASS, 3000EX	1	31	303181	9" GROUND WIRE W/RING TERMINAL	1
12	300125	M4X11 STANDOFF	9	32	303112	TERMINAL BOARD, 3000EX	4
13	303220	DISPLAY ASSEMBLY, 3000EX	1	33	300176	50 PIN X 9" RIBBON CABLE	1
14	300138	SPRING WASHER, M4, ZC-STEEL	30	34	300177	4 PIN X 12" POWER RIBBON CABLE	1
15	303137	M4 X 16MM PHILLIPS PAN SCREW	6	35	303241	KEYBOARD BARRIER CABLE, 3000EX	1
16	303110	PC BOARD ASSEMBLY, 3000EX	1	36	303164	TERMINAL COVER, 3000EX	1
17	300137	PHILLIPS PAN M4X8 ZX-STEEL	24	37	303165	RELAY TERMINAL COVER, 3000EX	1
18	3001482	THERMAL PAD	1				
19	303120	RADIATOR	1				
20	300797	REPLACABLE BATTERY	1				

TCS 3000ex NPT Class 1 Division 1 Parts List



ITEM	PART NO.	DESCRIPTION	QTY.	ITEM	PART NO.	DESCRIPTION	QTY.
1	303011-2	UL NAMEPLATE, 3000EX	1	21	303171D	M8 X 45MM SOCKET CAP SCREW, 18-8 DRILLED	1
2	303131	KEYBOARD BEZEL	1	22	303171	M8 X 45MM SOCKET CAP SCREW, 18-8 SS	15
3	303230	KEYBOARD, 3000EX	1	23	303156R	CALIBRATION SCREW SOCKET CAP 18-8 SS, 3000EX	1
4	300144	KEYBOARD GASKET	1	24	303159	M4 X 8MM TORX HEAD SCREW, 18-8 SS	4
5	303150	FRONT COVER, 3000EX	1	25	303011-3	WARNING PLATE, UL C1D1 ONLY	2
6	300122	SKT CNTRS NK SCREW M3X8	3	26B	303280	REAR HOUSING, 3000EX NPT (C1D1 ONLY)	1
7	303172B	HINGE B, 3000EX	2	27B	303253	PLUG, 1/2 NPT C1D1 C&D (C1D1 ONLY)	8
8	303173	M6 X 12MM FLAT HEAD HEX DRIVE, SS	8	28	790660	10-32 X 3/8 PAN HEAD SCREW, GREEN	1
9	303231	KEYBOARD CABLE, 3000EX	1	29	790676	10-32 INTERNAL TOOTH LOCKWASHER	1
10	303146	GASKET, 7" DISPLAY	1	30	303174	HOUSING ORING, 3000EX	1
11	303147	PROTECTIVE GLASS, 3000EX	1	31	303181	9" GROUND WIRE W/RING TERMINAL	1
12	300125	M4X11 STANDOFF	9	32	303112	TERMINAL BOARD, 3000EX	4
13	303220	DISPLAY ASSEMBLY, 3000EX	1	33	300176	50 PIN X 9" RIBBON CABLE	1
14	300138	SPRING WASHER, M4, ZC-STEEL	30	34	300177	4 PIN X 12" POWER RIBBON CABLE	1
15	303137	M4 X 16MM PHILLIPS PAN SCREW	6	35	303241	KEYBOARD BARRIER CABLE, 3000EX	1
16	303110	PC BOARD ASSEMBLY, 3000EX	1	36	303164	TERMINAL COVER, 3000EX	1
17	300137	PHILLIPS PAN M4X8 ZX-STEEL	24	37	303165	RELAY TERMINAL COVER, 3000EX	1
18	3001482	THERMAL PAD	1				
19	303120	RADIATOR	1				
20	300797	REPLACABLE BATTERY	1				

Appendix A– Relay Contact Ratings



RELAYS DESCRIPTION

The TCS 3000ex System features seven relay outputs and one optical relay used for controlling external devices.

CONTACT RELAYS RATINGS

Maximum voltage: $U_m = 50\text{Vdc}$

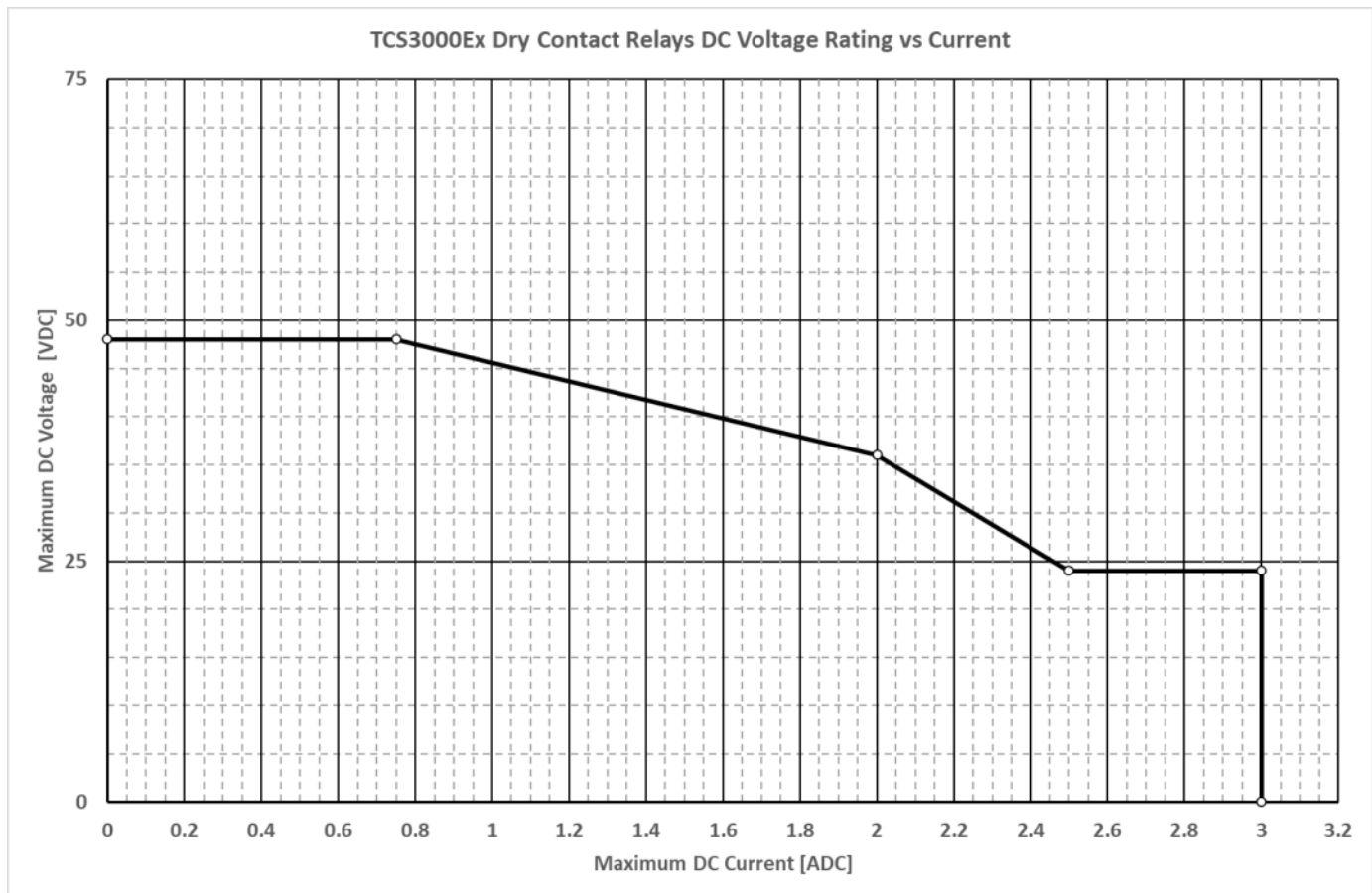
Maximum current rating:

Relay Signal voltage [V] ⁽²⁾	Maximum current [mA] ^{(1) (2)}
24Vdc	3000
36Vdc	2000
48Vdc	750

Notes:

(1) $L/R < 7\text{ms}$

(2) DC or AC rms



OPTICAL RELAY RATINGS

Maximum forward voltage U_m (OFF state): 32Vdc

ON state voltage (typical): 0.3Vdc

Maximum reverse voltage: -5Vcd

Maximum leakage current (OFF state): 0.2 μA

Maximum current (ON state):⁽¹⁾ 1.5 mA

Maximum parallel capacitance: 0.475 μF

Maximum serial inductance: 120 mH

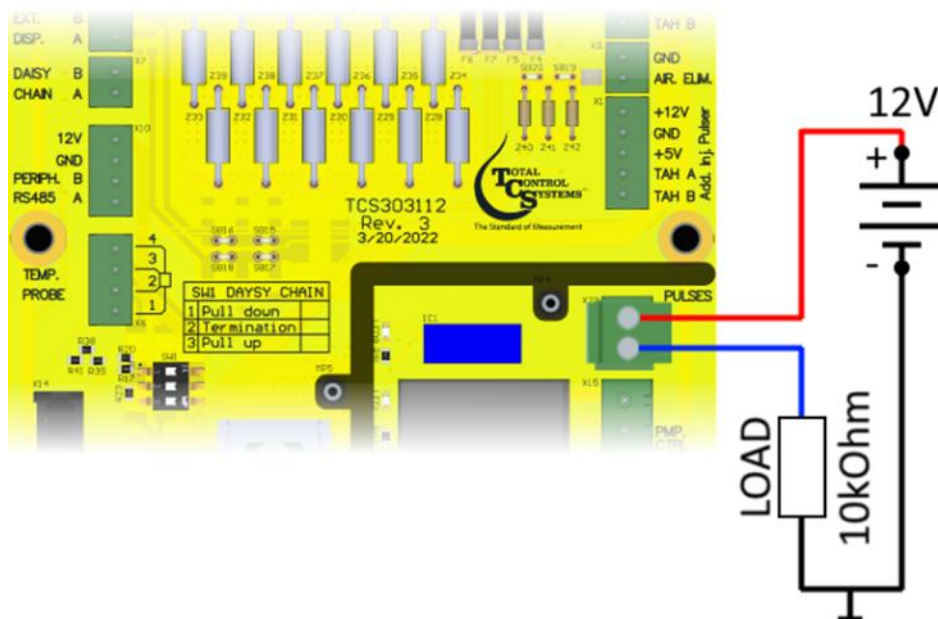
Note:

- Optical relay output to be used with resistive load only or in combination with freewheeling diode.
- The current must be limited by external resistor.

Appendix B– Input and Output Parameters



Optical relay example installation for 12V and 1mA (for equipment without pulldown resistance):



GENERAL DESCRIPTION

This section describes in detail the main loading ratings of the supply to external circuits, rated input voltages as well as the internal I.S. barrier output parameters.

Note: The relay contact ratings are described in detail in APPENDIX A above.

The register TCS 3000ex is intended for use and interfacing to devices in the following Hazardous (Classified) Areas:

- Class1, Division 1, Groups C & D
- Group 1, Zone 1, EPL “Gb”.

The TCS 3000ex register can be interfaced to devices which require I.S. barrier inputs or outputs to comply with IEC 60079–11.

Note: When calculating capacitive and inductive loading, if the cable manufacturer has not specified cable capacitance and serial inductance – use 60pf/ft (200pF/m) for capacitance and 0.2μH/ft (1μH/m) for inductance , in accordance with IEC 60079–14.



WARNING: The user is responsible for selecting the external devices connected to the TCS 3000ex register in such way that they are compliant with the safety requirements of the area in which the system is used, as well as observing the wiring requirements and the limiting values for the interfaces to the TCS 3000ex. The information below is provided in order to ease the selection of suitable devices and cabling which can be connected to the TCS 3000ex This information does not replace in any way any local regulations or additional limiting factors arising from the environment in which the system is installed.

Appendix B—Input and Output Parameters (continued)

EXTERNAL PULSERS

The TCS 3000ex register supplies power to the external pulsers which must have “db” enclosures. The interconnection is “db” to “db” and no additional I.S. barriers are provided. The end user is responsible to comply with the ratings below and to install cabling which will comply with the requirements for “db” to “db” connection.

NOMIAL RATINGS OF THE PULSER SUPPLY LINES

#	Supply Line	NOMINAL RATINGS	
		Output Voltage [V]	Max. Current [mA]
1	Main Pulser 12V supply ⁽³⁾	12.0	100
2	Main Pulser 5V supply ⁽³⁾	5.0	100
3	Additive Injection Pulser 5V supply ⁽³⁾	5.0	100

LIMITING VALUES OF THE PULSER SUPPLY LINES

#	Supply Line	Absolute Maximum Output Voltage [V]	Maximum allowed Loading	
			Current [mA]	Pmax [mW]
1	Main Pulser 12V supply ⁽³⁾	13.2	100	330
2	Main Pulser 5V supply ⁽³⁾	5.6	100	140
3	Additive Injection Pulser 5V supply ⁽³⁾	5.6	100	140

RATINGS OF THE PULSER SIGNAL LINES

#	Pulser Signal Lines	Logical Levels		Um Absolute Maximum Signal Voltage [V]
		Low Level < [V]	High Level > [V]	
1	Main Pulser signal lines ⁽³⁾⁽⁴⁾	0.7	3.5	6.0
2	Additive Injection Pulser signal lines ⁽³⁾⁽⁴⁾	0.7	3.5	5.6

Notes:

- (1) Internally pulled up to 3.3V, connected to air eliminator open/close contact
- (2) Internally generated voltage, data only for reference
- (3) “db” to “db” connection – no I.S. barrier
- (4) “db” to “db” connection – values for reference only

Appendix B—Input and Output Parameters (continued)

PERIPHERAL PARAMETERS SENSORS

Interface	Uo [V]	Isc [mA]	Pmax [mW]	Co [uF]	Lo [mH]
Temperature probe ⁽²⁾	5.88	228	335	1000	6.2
Air Eliminator ⁽¹⁾⁽²⁾	6.94	25.53	44.3	16.8	64.24

BI-DIRECTIONAL COMMUNICATION INTERFACES

Interfaces in transmit mode (Outputs – supplying energy) ⁽⁵⁾

Interface	Uo [V]	Isc [mA]	Pmax [mW]	Co [uF]	Lo [mH]
RS232 H/H PC "COMP." ⁽⁶⁾	13.60	34	116	5.2	0.28
RS232 Printer "PRINT." ⁽⁷⁾	13.6	34	116	5.2	0.28
RS485 Ext. Display "EXT.DISPLAY" ⁽⁸⁾	5.36	108	145	1000	27.43

Interfaces in receiving mode (Inputs – receiving energy):

Interface	Ui [V]	Ii [mA]	Pi [mW]	Ci [uF]	Li [mH]
RS232 H/H PC "COMP." ⁽⁶⁾	±30	23.52	176	0.066	0.01
RS232 Printer "PRINT." ⁽⁷⁾	±30	23.52	176	0.066	0.01
RS485 Ext. Display "EXT.DISPLAY" ⁽⁸⁾	5.9	56	204	0.012	0.01

NON-I.S. "db to db" INTERFACES ⁽³⁾⁽⁴⁾

Interfaces in transmit mode (Outputs – supplying energy)

Interface	Um [V]
RS485 Daisy Chain ⁽³⁾⁽⁴⁾⁽¹⁹⁾	7.14
RS485 Peripheral Interface	7.14
Pulse Out (Optical Relay Out)	12V

Notes:

- (1) Internally pulled up to 3.3V, connected to air eliminator open/close contact
- (2) Internally generated voltage, data only for reference
- (3) "db" to "db" connection – no I.S. barrier
- (4) "db" to "db" connection – values for reference only
- (5) The values of Lo and Co in the tables above shall be reduced by 50% if both of the following conditions are met:
the total Li of the external circuit (excluding cable) ≥ 1% of Lo and the total Ci of the external circuit (excluding cable) ≥ 1% of Co value
The reduced capacitance of the external circuit (including cable) shall not be greater than 1 µF for Group IIB.
The values of Lo and Co shall not be exceeded by the sum of all the Li plus cable inductances in the circuit and the sum of all of Ci plus cable capacitances respectively.
- (6) "COMP." port is connection to host PC situated in ATEX Zone 2. Its RS232 driver must be compatible with Vcc up to 12VDC.
- (7) "PRINT." port is connection with a printer situated in ATEX Zone 2. The printer RS232 driver must be compatible with Vcc up to 12VDC.
- (8) "EXT.DISPLAY" port is point-to-point connection with a remote display situated in ATEX Zone 2.
- (9) "DAISY CHAIN" port is multipoint connection with other TCS 3000ex registers with "db" to "db" connection – values for reference only.

NOTES

WARRANTY

New TCS 3000ex electronic registers, equipment or components manufactured by Total Control Systems, a division of Murray Equipment, Inc. (TCS) with which this warranty is enclosed, are warranted by TCS to the original purchaser only for a period of TWELVE (12) months from installation or eighteen (18) months from the date of shipment, to be free, under normal use and service, from defects in material and workmanship.

Defects occurring within the stated warranty period, TCS will repair or replace, at TCS's option; provided that part or parts are returned to TCS transportation charges prepaid, and TCS's examination discloses the parts or workmanship to have been defective upon delivery to the purchaser.

EXCLUSIONS

Warranty does not cover any parts and equipment not manufactured by TCS, but these items may be covered by separate warranties of their respective manufacturers. This warranty does not extend to any equipment that has been subjected to misuse, negligence or accident or if operated in any manner other than in accordance with TCS's operating instructions and specifications.

CLAIM PROCEDURES

In order to obtain performance by TCS of its obligations under this warranty, the original purchaser must obtain a Return Goods Authorization (RGA) number from TCS's customer service department within 30 days of discovery of a purported breach of warranty, but not later than the expiration of the warranty period. Once authorization is received, return the defective meter, piece of equipment, or component covered by this warranty, with transportation charges prepaid, to TCS at the address shown below together with a written statement setting forth the nature of the defect and RGA number.

LIMITATIONS

THERE ARE NO OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED. TCS SPECIFICALLY DISCLAIMS ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR ANY PARTICULAR PURPOSE. TCS will determine if all parts or meter defect falls within the warranty guidelines and will repair or replace within a reasonable time span. TCS is not responsible for any in or out bound freight. TCS's sole obligation that shall represent the buyer's sole and exclusive remedy shall be to repair or at TCS's option to replace any product or part determined to be defective. In no event shall TCS be liable for any special, direct, indirect, incident, consequential or other damages of similar nature, including without limitation, loss of profits, products, production time, or loss of expenses of any nature incurred by the buyer or any third party. TCS has not authorized on its behalf any representation or warranties to be made, nor any liability to be assumed except as expressly provided herein; there is no other express or implied warranty.

DESIGN AND EQUIPMENT CHANGES

Any changes in design or improvements added shall not create any obligation to install same on equipment previously sold or ordered.



The Standard of Measurement

2515 Charleston Place
Fort Wayne, IN 46808

Phone: (260) 715-4500
Email: sales@tcsimeters.com
Website: www.tcsimeters.com

Check us out at www.TCSimeters.com!