WOODWARD

Product Manual 26815
(Revision J, 1/2021)
Original Instructions

QuickTrip
Electro-Hydraulic Trip Block Assembly

Installation and Operation Manual

General Precautions

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment.

Practice all plant and safety instructions and precautions.

Failure to follow instructions can cause personal injury and/or property damage.

Revisions

This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, check manual *26455*, *Customer Publication Cross Reference and Revision Status & Distribution Restrictions*, on the *publications page* of the Woodward website:

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The latest version of most publications is available on the *publications page*. If your publication is not there, please contact your customer service representative to get the latest copy.

Proper Use

Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.

Translated Publications

If the cover of this publication states "Translation of the Original Instructions" please note:

The original source of this publication may have been updated since this translation was made. Be sure to check manual *26455*, *Customer Publication Cross Reference and Revision Status & Distribution Restrictions*, to verify whether this translation is up to date. Out-of-date translations are marked with ⚠. Always compare with the original for technical specifications and for proper and safe installation and operation procedures.

⚠CAUTION

All persons involved in the installation and maintenance of the Quick Trip unit must have appropriate training. The calibration and checkout procedure should only be performed by authorized personnel knowledgeable of the risks posed by live electrical equipment.

⚠CAUTION

The power supply mains should be properly fused according to the National Electrical Code. The recommended fuse is a European Type T fuse.

⚠CAUTION

A switch or circuit breaker shall be included in the building installation that is in close proximity to the equipment and within easy reach of the operator and that is clearly marked as the disconnecting device for the equipment. The switch or circuit breaker shall not interrupt the protective earth conductor.

⚠WARNING

The external ground lugs shown on the installation drawing must be properly connected to ensure equipotential bonding. This will reduce the risk of electrostatic discharge in an explosive atmosphere.

Any cleaning by hand or with water spray must be performed while the area is known to be non-hazardous to prevent an electrostatic discharge in an explosive atmosphere.

Revisions— A bold, black line alongside the text identifies changes in this publication since the last revision.

Manual 26815

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Warnings and Notices

Important Definitions

This is the safety alert symbol used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

- **DANGER** - Indicates a hazardous situation, which if not avoided, will result in death or serious injury.
- **WARNING** - Indicates a hazardous situation, which if not avoided, could result in death or serious injury.
- **CAUTION** - Indicates a hazardous situation, which if not avoided, could result in minor or moderate injury.
- **NOTICE** - Indicates a hazard that could result in property damage only (including damage to the control).
- **IMPORTANT** - Designates an operating tip or maintenance suggestion.

⚠WARNING

Overspeed / Overtemperature / Overpressure

The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

⚠WARNING

Personal Protective Equipment

The products described in this publication may present risks that could lead to personal injury, loss of life, or property damage. Always wear the appropriate personal protective equipment (PPE) for the job at hand. Equipment that should be considered includes but is not limited to:

- **Eye Protection**
- **Hearing Protection**
- **Hard Hat**
- **Gloves**
- **Safety Boots**
- **Respirator**

Always read the proper Material Safety Data Sheet (MSDS) for any working fluid(s) and comply with recommended safety equipment.

⚠WARNING

Start-up

Be prepared to make an emergency shutdown when starting the engine, turbine, or other type of prime mover, to protect against runaway or overspeed with possible personal injury, loss of life, or property damage.

Electrostatic Discharge Awareness

NOTICE

Electrostatic Precautions

Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts:

- **Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).**
- **Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.**
- **Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.**

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual *82715*, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Follow these precautions when working with or near the control.

1. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as much as synthetics.
2. Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:
   - Do not touch any part of the PCB except the edges.
   - Do not touch the electrical conductors, the connectors, or the components with conductive devices or with your hands.
   - When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.

Regulatory Compliance

IMPORTANT

The certifications and regulatory information that are marked on each QuickTrip valve are determined by the Item Prefix that appears before the Item Number (See Table 1-1). This Item Prefix appears on the product nameplate and sales documentation. This section has been indexed to show which certificates apply to which item prefix.

European Compliance for CE Marking:
These listings are limited only to those units bearing the CE Marking and the appropriate agency certification marking.

EMC Directive Declared to 2014/30/EU of the European Parliament and of the Council of 26 February on the harmonisation of the laws of the Member States relating to electromagnetic compatibility (EMC).
Item Prefix(es): ALL

ATEX Directive: Declared to 2014/34/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres.
Item Prefix(es): 1, 3 -
Zone 1: II 2 G, Ex db IIB T4 Gb,
SIRA15ATEX1230X
Item Prefix(es): 1, 2, 3, 4 -
Zone 2: II 3 G, Ex nA nC IIC T4 Gc,
SIRA15ATEX4231X

Other European and International Compliance:
Compliance with the following European Directives or standards does not qualify this product for application of the CE Marking:

ATEX Directive: Exempt from the non-electrical portion of the ATEX Directive 2014/34/EU due to no potential ignition sources per EN ISO 80079-36:2016 for Category 2.

Machinery Directive: Compliant as partly completed machinery with Directive 2006/42/EC of the European Parliament and the Council of 17 May 2006 on machinery.

Pressure Equipment Directive: Compliant as “SEP” per Article 4.3 to Pressure Equipment Directive 2014/68/EU on the harmonisation of the laws of the Member States concerning pressure equipment.

EAC Customs Union
These listings are limited only to those units with labels, marking, and manuals in Russian language to comply with their certificates and declaration.

EAC Customs Union (Marked) Certified to Technical Regulation CU 012/2011 for use in potentially explosive atmospheres per Certificate RU C-US.МЮ62.B.02276 as
Item Prefix(es): 3 -
1Ex d IIB T4 Gb X
Item Prefix(es): 3, 4 -
2Ex nA IIC T4 Gc X

EAC Customs Union Declared to Technical Regulation CU 020/2011 On Electromagnetic Compatibility of Technical Equipment Declaration of Conformity
Registration No: RU Д-US.АЛ32.В.05234
Item Prefix(es): 3, 4

Other International Compliance
These listings are limited only to those units bearing the appropriate agency certification marking.

IECEx: Certified for use in explosive atmospheres per Certificate:
IECEx CSA 15.0009X
Item Prefix(es): 1, 3 - Ex db IIB T4 Gb
Item Prefix(es): 1, 2, 3, 4 - Ex nA IIC T4 Gc

North American Compliance:
These listings are limited only to those units bearing the CSA identification

CSA: (Item Prefix: 1) CSA Certified For Class I, Division 1, Groups C & D, Class I, Division 2, Groups A, B, C, & D, T4 at 85 °C Ambient. For use in Canada and the United States. Certificate 2757391

CSA: (Item Prefix: 2) CSA Certified For Class I, Division 2, Groups A, B, C, & D, T4 at 85 °C Ambient. For use in Canada and the United States. Certificate 2757391

SIL Compliance:

SIL-3: Product has been evaluated to IEC 61508 Parts 1-2 and 4-7:2010 as well as IEC 61511 Parts 1-3:2004 (in extracts) and has been found to be suitable for use in a safety instrumented system up to SIL-3. The instructions of the associated installation and Operating Manual shall be considered and followed – reference “Safety Management” in Chapter 6 of this manual. See end of this manual for certificate and test results. Certificate V 486.01./15

Special Conditions for Safe Use

Field wiring must be suitable for at least +85 °C and 10 °C above the maximum fluid and ambient temperatures.

The maximum hydraulic fluid temperature shall not exceed 70°C.

Conduit stops must be installed within 45cm (18 inches) of the QuickTrip product in order to meet the Zone 1 classification.

The following have a maximum constructional gap (ic) less than that required by Table 2 of EN 60079-1 and hence are as detailed below:

Flamepath	Max Gap, ic (mm)	Min. width of joint L (mm)
Sleeve to Spacer	0.08	12.852
Rotor to Spacer	0.08	13.46
Sleeve to Carrier	0.0483	14.757
Sleeve to Housing	0.178	14.097

Under certain extreme circumstances, the non-metallic parts incorporated in the enclosure of this equipment may generate an ignition-capable level of electrostatic charge. Therefore the equipment shall not be installed in a location where the external conditions are conducive to the build-up of electrostatic charge on such surfaces. In addition, the equipment shall only be cleaned with a damp cloth.

The Temperature Code T4 (135 °C) may be exceeded if QuickTrip is cycled on and off at a frequency exceeding 1 Hz. This is considered a rare malfunction and not part of the intended use of the device.

Connect external safety ground terminal to earth ground.

For installation using Ex nA nC protection:

1. Transient protection of QuickTrip is to be provided externally by the end user. The transient protection device is to be set at a level not exceeding 140% of the peak rated voltage.
2. The installation of QuickTrip shall only be within a Pollution Degree 2 environment as defined in IEC 60664-1.
3. Minimum ambient temperature shall not be lower than -20 °C

Compliance with the Machinery Directive 2006/42/EC noise measurement and mitigation requirements is the responsibility of the manufacturer of the machinery into which this product is incorporated.

Do not connect/disconnect/substitute components

WARNING - Explosion Hazard—Do not remove covers or connect/disconnect electrical connectors unless power has been switched off or the area is known to be non-hazardous.

Substitution of components may impair suitability for Class I, Division 2 or Zone 2 applications.

AVERTISSEMENT - Risque d'explosion— Ne pas enlever les couvercles, ni raccorder / débrancher les prises électriques, sans vous en assurez auparavant que le système a bien été mis hors tension; ou que vous situez bien dans une zone non explosive.

La substitution de composants peut rendre ce matériel inacceptable pour les emplacements de Classe I, applications Division 2 ou Zone 2.

Chapter 1.
General Information

Introduction

The QuickTrip trip block assembly is designed for use in gas or steam turbine shutdown systems for quick and reliable dumping of the turbine's trip oil header. This integrated trip block assembly is intended for use on mechanical-drive or generator-drive gas or steam turbines that use low-pressure (up to 34.5 bar / 500 psi) hydraulic trip oil headers.

The QuickTrip's fault tolerant design makes it ideal for critical gas or steam turbine applications, where turbine up-time and availability are essential. This trip block assembly's 2-out-of-3 voting design provides users with a very high level of system reliability as well as compliance with industry standard API-670.

This trip block assembly is designed to allow turbine controls and/or turbine safety systems to quickly dump (bleed off) hydraulic header pressure during emergency trip or normal trip conditions. When applied in conjunction with Woodward's ProTechTPS logic solver, the QuickTrip allows users to independently test each trip leg to verify operation and trip time. API-670 5th edition requires that all components except for the final element (trip valve) shall be routinely tested while the turbine is in operation.

With the use of trip solenoids which respond in less than 50 milliseconds, the QuickTrip is designed for gas or steam turbine trip systems where it is imperative the entire trip system shut the system trip valve as quickly as possible.

The QuickTrip's robust design (corrosion resistant materials, three independent moving rotary valves, and self-cleaning port design) makes it optimal for challenging applications where dirty or contaminated oil may be present.

The QuickTrip is certified for use in IEC61508 based turbine safety systems, and when paired with the Woodward ProTechTPS, can be applied into systems that require a "Safety Integrity Level – 3" rating or below.

Designed for use in new or retrofit turbine packages, the QuickTrip's compact package size allows it to be located near the turbine and trip & throttle valve, minimizing trip header piping and related system delays. Each trip leg includes bright position indication LEDs (run & trip) to allow turbine operators to quickly verify system status locally near the turbine as well as integrated limit switches for safety system and plant DCS status and health validation.

The QuickTrip is an IEC61508 safety certified electro-hydraulic trip block assembly designed for use in gas or steam turbine shutdown systems for quick and reliable dumping of the turbine's trip oil header. This trip block assembly's 2-out of-3 voting design provides users with a high level of system reliability as well as compliance with industry standards like API-670, API-612, and API-611.

This trip block assembly is housed in a fully integrated package which includes three patented dirt-tolerant rotary trip valves. These valves are connected to provide redundant two-out-of-three based voting to ensure that a failure of any one component (electronics module, valve, wiring, connector, etc.) does not result in a nuisance trip condition. The QuickTrip's modular design also allows users to replace critical components (electrical module, solenoid, wiring, etc.) while the turbine is operating on-line.

Designed to quickly and reliably bleed off trip oil header pressure, at least two of the QuickTrip's three rotary solenoid valves must be de-energized to open a bleed path from the trip oil header to system drain.

The QuickTrip accepts one or two (redundant) 24 Vdc power sources to power each solenoid, and uses three independent discrete input shutdown commands from a safety logic solver like the Woodward ProTechTPS (independent voted models) to test and control each solenoid valve.

Because gas and steam turbines are often used in hazardous locations where flammable gases may be present, the QuickTrip is designed to be mounted next to the turbine and is certified for use in Zone-1 or Zone-2 (Class 1 or Class 2) hazardous locations.

When packaged with a Woodward ProTechTPS safety logic solver, the ProTechTPS performs the required routine safety system diagnostic tests to verify unit operation while the turbine is on-line, and the proof test trip time response monitoring and logging ensures the total turbine safety system can respond fast enough to safely shutdown the turbine.

The total installed cost for this fully integrated trip block assembly is low because it has been completely assembled and tested at the factory. This greatly reduces OEM and end-user fabrication time, installation time, and testing time.

Dirt Tolerance

The QuickTrip is specifically designed for gas and steam turbine applications where turbine lube oil is also used to power the hydraulic turbine control valve actuator(s). Gas and steam turbine applications can be extremely challenging for hydraulic trip block assemblies as dirt, metal shavings, water, and other contaminants are common in such oil systems. Also due to the high temperatures at which turbines operate, turbine oil breakdown is common, resulting in the creation of a sludge-type substance and the varnishing of internal system components. However, the QuickTrip is designed to operate reliably within such challenging applications. Its corrosion-resistant materials, rotary valve design, and self-cleaning ports allow it to operate in such applications without experiencing undesirable sticking or dragging.

In the past, older style trip block assemblies utilized internal orifices and pressure gauges to verify solenoid valve operation, causing many maintenance problems when applied in turbine lube-oil-powered trip systems. Since the QuickTrip does not utilize problematic orifices or pressure gauges, maintenance is reduced and system reliability improved.

Valve Status (local & remote)

Each valve solenoid accepts power for one or two (redundant) power sources and has the following status indications to assist operators with understanding the status and health of each valve.

- Valve Open—Local LED (red)
- Valve Open—Limit Switch
- Valve Closed—Local LED (green)
- Valve Closed—Limit Switch
- Power Supply #1 Healthy—Local LED (blue)
- Power Supply #2 Healthy—Local LED (blue)

Redundancy/Availability

Designed for use in critical gas and steam turbine applications where turbine up time is important, the QuickTrip uses three isolated solenoid valves designed to be driven by a triple modular redundant 2-out-of-3 voting based safety logic solver. Each isolated solenoid valve uses redundant power supply inputs to increase both system reliability and availability. Note: Only one power source is required to power/energize each of the isolated solenoid valves.

On-Line Repairable

The QuickTrip’s modular design allows independent repair/replacement of each valve’s solenoid, electrical module, and associated power supplies and wiring to increase both system reliability and availability. Note: Only one power source is required to power/energize each of the isolated solenoid valves.

Chemically Resistant Versions

For steam turbine applications where lube oil contains harsh chemical contaminants (ammonia, hydrogen sulfide etc), a chemically resistant version of the QuickTrip has been developed. Chemically resistant versions feature best in class seals in all wetted locations within the trip block assembly. Chemically resistant versions provide an optimal solution for extreme chemical resistance while still maintaining QuickTrip operating pressure and temperature ranges. Please contact Woodward for available models and information regarding chemical resistance for specific applications.

Construction

The QuickTrip is made up of the following major components:

1. Hydraulic Manifold
2. Three Independently Actuated, Spring Return Rotary Trip Valves
3. Feedback Sensors: Limit Switches
4. Integrated Electric Actuators and Electronics Modules

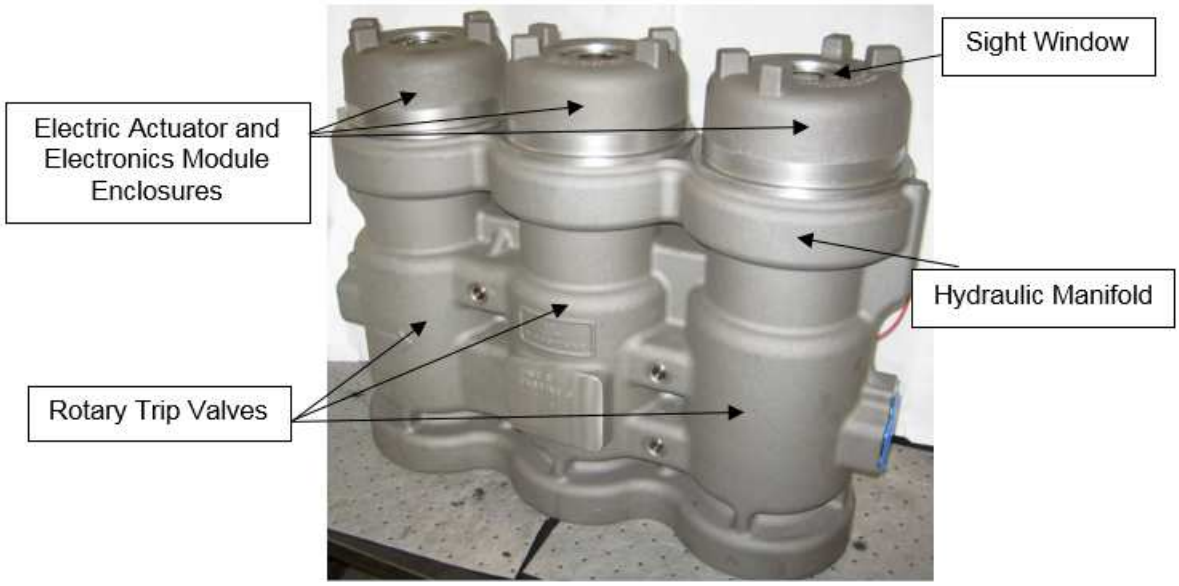

Figure 1-1. QuickTrip, Key Features

Rotary Trip Valves

All three of the QuickTrip's trip valves are spring return, two position rotary valves. When any of the hydraulic valves is in its closed position, the ports in the valve are blocked preventing hydraulic flow through the valve. As a valve rotates to the tripped position, the ports open and the trip header pressure is connected to either the drain, or the inlet ports of another one of the valves. The combined action of the three valves results in trip header pressure being connected to drain only when 2 or 3 valves are tripped.

If the unit detects any shutdown condition or loss of power occurs, the trip valve return springs will force the valves to the fail-safe / tripped position.

Electric Valve Actuators

The QuickTrip uses a set of three unique rotary solenoids called limited angle torquers (LAT). The permanent magnet rotor is directly coupled to the trip valve.

The position of the valves is sensed by two limit switches present on each of the electrical modules. These limit switches are located on both the closed and tripped positions of the valves, allowing the user to easily determine the position of each valve.

Electronic Driver Modules (PCB)

The printed circuit boards (PCB) are mounted on of the top of each valve module. The PCB(s) performs the following tasks:

- Trip Demand Input
- Dual Redundant Power Inputs
- Valve Position Feedback Discrete Outputs
- Visual Valve Position Indication

Discrete outputs are provided for position feedback indication of each valve module. Within each valve module, there are also four LEDs that indicate the current condition of the module as well as power supply health. These LEDs are viewable through the transparent sight window of the module covers.

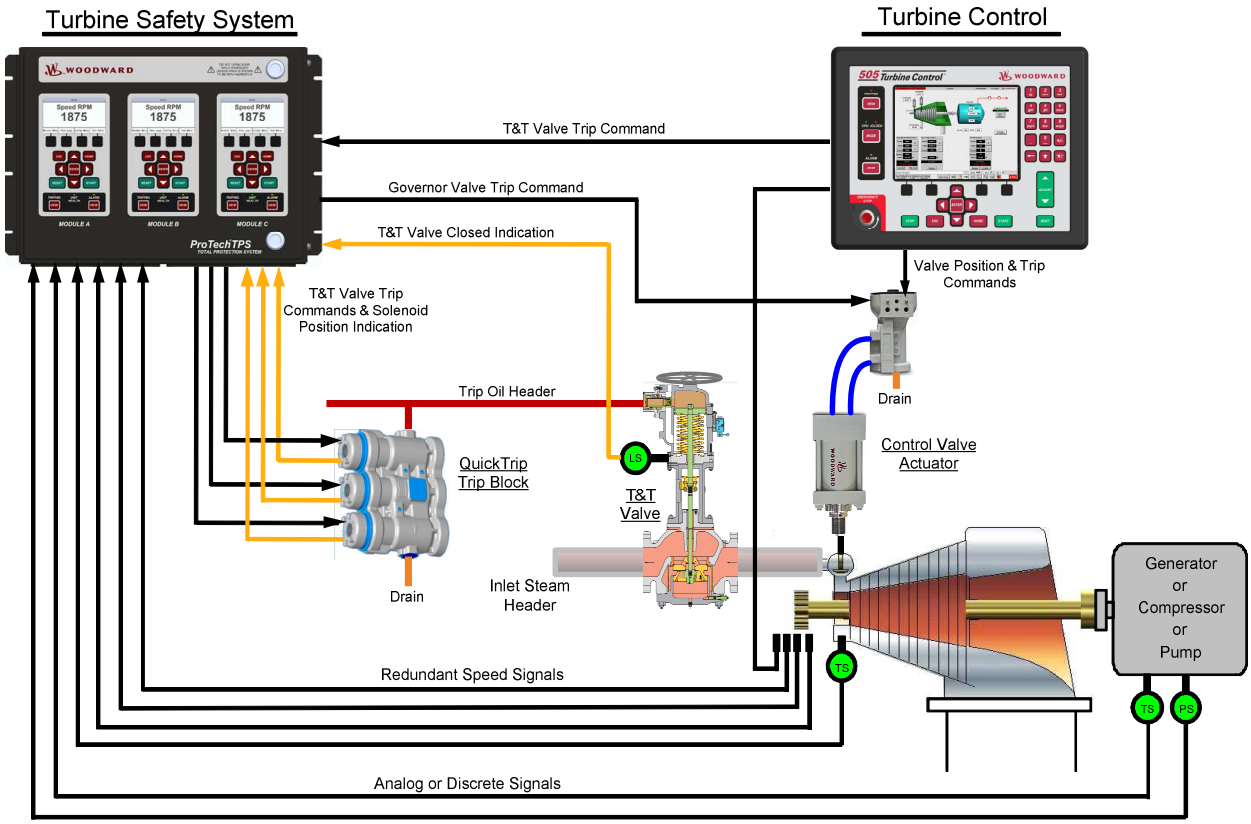

Figure 1-2. Application Example

Table 1-1. QuickTrip Part Numbers

Item Prefix	Item Number	Description	Primary Language
0	9907-1978	CE Mark for Ordinary Location	English
1	9907-1978	North American Div 1 & 2, ATEX/IECEx Zone 1 & 2	English
2	9907-1978	North American Div 2, ATEX/IECEx Zone 2	English
3	9907-1978	North American Div 1 & 2, EAC CU/ATEX/IECEx Zone 1 & 2	Russian
4	9907-1978	North American Div 2, EAC CU/ATEX/IECEx Zone 2	Russian
0	9907-2108	Chem Resistant CE Mark of Ordinary Location	English
1	9907-2108	Chem Resistant North American Div 1 & 2, ATEX/ IECEx Zone 1 & 2	English
2	9907-2108	Chem Resistant North American Div 2, ATEX/IECEx Zone 2	English
3	9907-2108	Chem Resistant North American Div 1 & 2, EAC CU/ATEX/ IECEx Zone 1 & 2	Russian
4	9907-2108	Chem Resistant North American Div 2, EAC CU/ATEX/ IECEx Zone 2	Russian

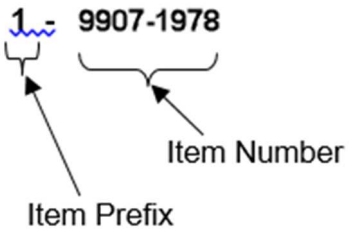

Figure 1-3. Ordering Example

Note: 9907-1978 is used as an example. Contact Woodward for latest item number(s).

Table 1-2. Recommended QuickTrip Spare Part Kits

Part Number	Spare Kit Description
8923-2142	Solenoid Replacement Kit
8923-2146	Electrical Module Replacement Kit
8923-2147	Return Spring Replacement Kit
8923-2192	Field Repair Tool Kit - (Includes special tools to replace the solenoid, return spring, sight window, top cover, & rotor)

Table 1-3. Optional QuickTrip Spare Part Kits

Part Number	Spare Kit Description
8923-2191	Rotor Replacement Kit
8923-2143	Sight Window Replacement Kit
8923-2690	Top Cover Replacement Kit
8923-2145	Bottom Cover Replacement Kit

Chapter 2.
Specifications

Physical and Performance Specifications

Solenoid Response Time:	< 50 ms*
Failsafe Operation:	Internal return spring on each solenoid valve
Weight:	110 kg (242 lb)
Mounting:	Vertical Mounting

* Solenoid Response Time represents the valve trip time and is defined as the time from when the solenoid is de-energized to the time when the valves are at full open position.

Environmental Specifications

Ambient Temperature:	(–40 to +85) °C / (–40 to +185) °F
Ex nA nC Minimum Ambient Temperature:	-20 °C (-4 °F)
Vibration Resistance:	MIL-STD 810F, M514.5A, Cat. 4 (0.015 G²/Hz, 1.04 Grms)
Shock Resistance:	US MIL-STD-810C method 516.2, procedure 1 (10 G Peak, 11 ms duration, saw tooth)
Corrosion Resistance:	Two part epoxy paint coating. Designed for outdoor conditions
Ingress Protection (IEC 60529, IEC 60079-0):	IP66

Electrical Specifications

Supply Voltage:	24 Vdc nominal ± 10% (use cable at least 0.8mm² / 18 AWG)
Current Consumption:	8 A Max (2.6 A per channel Max) at steady state @ 24 V 10 A transient (100 ms maximum)
Control Input Voltage:	15-32 Vdc, 20 mA max
Feedback Output Signal:	Resistive: 2 A @ 28 Vdc, max 32 Vdc Inductive: 0.5 A @ 28 Vdc (max. 0.2 Henry)
Supply Voltage Connections:	Terminal suitable for 0.8 to 3.3 mm² or 18 to 12 AWG stranded wire
Control Input and Discrete Connections:	Removable terminal suitable for 0.8 to 3.3 mm² or 18 to 12 AWG stranded wire
Cable Entries:	3 X 0.750”-14 NPT 1 Ground

Hydraulic Specifications

WARNING

Make sure that the QuickTrip hydraulic connections are installed correctly. Equipment damage is possible if the hydraulic connections are attached incorrectly (backwards).

Fluid Type:	Petroleum-based hydraulic fluids as well as fire-resistant hydraulic fluids such as Fyrquel EHC
Maximum Trip Header Pressure:	34.5 bar (500 psi)

IMPORTANT

It is recommended to set hydraulic system pressure regulator to 110% or less of normal operating pressure to prevent over-pressure.

Proof Pressure:	51.7 bar (750 psig)
Burst Pressure:	86.2 bar (1250 psig)
Fluid Temperature:	15 to 70 °C / 59 to 158 °F continuous
Fluid Cleanliness Level:	ISO 4406 code 20/18/16 or cleaner
Fluid Filtration Level:	20 micron filter is recommended with a beta ratio of at least 200 (99.5% efficiency)
Hydraulic Connections:	Hydraulic Supply Port: 1.250 SAE Code 61 Flange Hydraulic Drain Port: 1.250 SAE Code 61 Flange
Oil Flow / Cv Rating:	Refer to following figures for Cv and Leakage Rates of the Valves

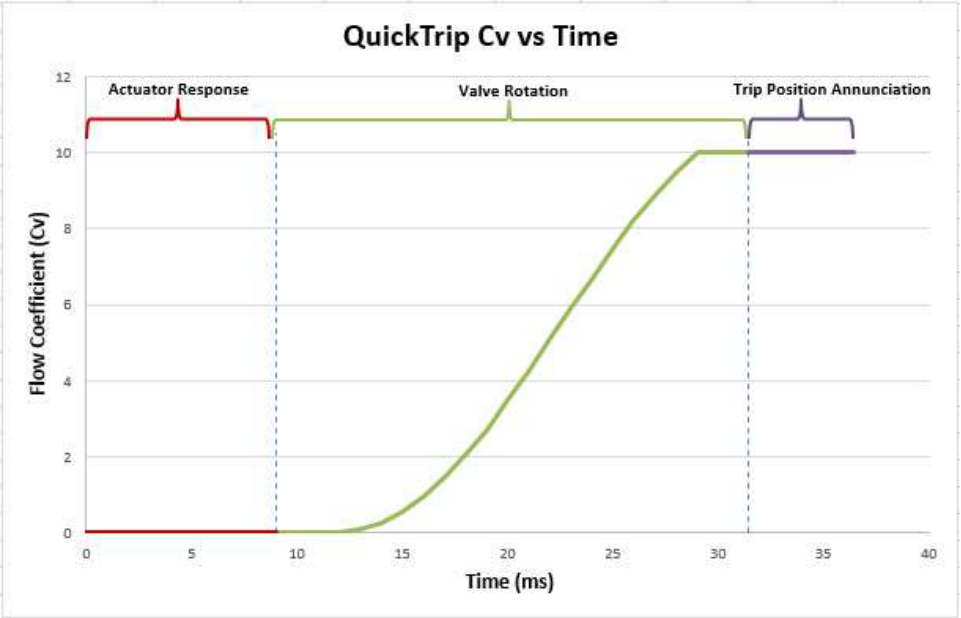

Figure 2-1. QuickTrip Cv vs Time Curve

IMPORTANT **The figure above shows the estimated, worse case Cv of the QuickTrip assembly with only 2 of the 3 three valves tripped.**

The table below shows the QuickTrip's Cv in the various tripped conditions.
Note: the actual Cv values may deviate by as much as ± 12% from the values shown.

Table 2-1. QuickTrip Cv in Trip Condition

Trip Condition	Cv
Trip A & B	10.3
Trip B & C	11.4
Trip A & C	11.9
Trip A, B & C	13.4

IMPORTANT **The figure above shows the typical Cv values for the QuickTrip assembly. Actual values may vary by as much as ± 12% from the values shown.**

Flow Coefficient (Cv):
The flow coefficient (Cv) of a valve is defined as the relationship between flow rate (Q), pressure drop (ΔP), and fluid specific gravity (SG). The equation for Cv is shown below. Note: the variables in the Cv equation must be in the correct units (GPM, psi) for values to be correctly calculated.

$$Cv = Q * \sqrt{\frac{SG}{\Delta P}}$$

$Where$:

$Cv = Flow\ Coefficient$
$Q = Flow\ Rate\ in\ Gallons\ Per\ Minute\ (GPM)$
$SG = Specific\ Gravity\ of\ Fluid$
$\Delta P = Pressure\ Drop\ Accros\ Valve\ in\ Pounds\ Per\ Square\ Inch\ (PSI)$

Flow Rate Calculation Example:
Calculate minimum flow rate through the QuickTrip with typical, ISO VG32 fluid at 15degC and a trip header pressure of 10 Bar.

$SG = 0.875$
$\Delta P = 10\ Bar = 145\ PSI\ (assume\ drain\ pressure = 0)$
$Cv = 10.3\ (minimum, only\ A\&B\ Tripped)$

$$Q = Cv / \sqrt{\frac{SG}{\Delta P}} = 10.3 / \sqrt{\frac{0.875}{145\ PSI}} = 132.6\ GPM = 501\ LPM$$

Steady State Leakage

The graphs below show the hydraulic steady-state leakage flow through QuickTrip with 50 °C and 70 °C hydraulic fluid. Each graph shows the leakage with the Channel A valve open, Channel B valve open, Channel C valve open and with all valves closed. The worst-case leakage flow through QuickTrip occurs with the Channel A valve open. The trip system orifice should be sized for this maximum leakage so that an auto sequence test that trips channel A to an open position will not cause the trip header pressure to fall below the trip point for the system.

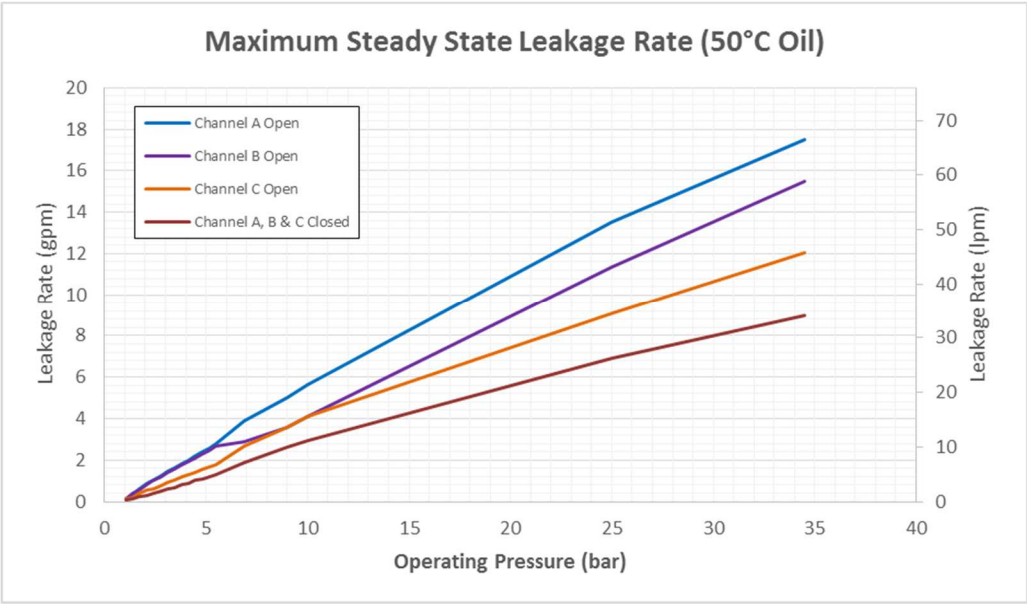

Figure 2-2. QuickTrip Steady State Leakage (50 °C hydraulic oil)

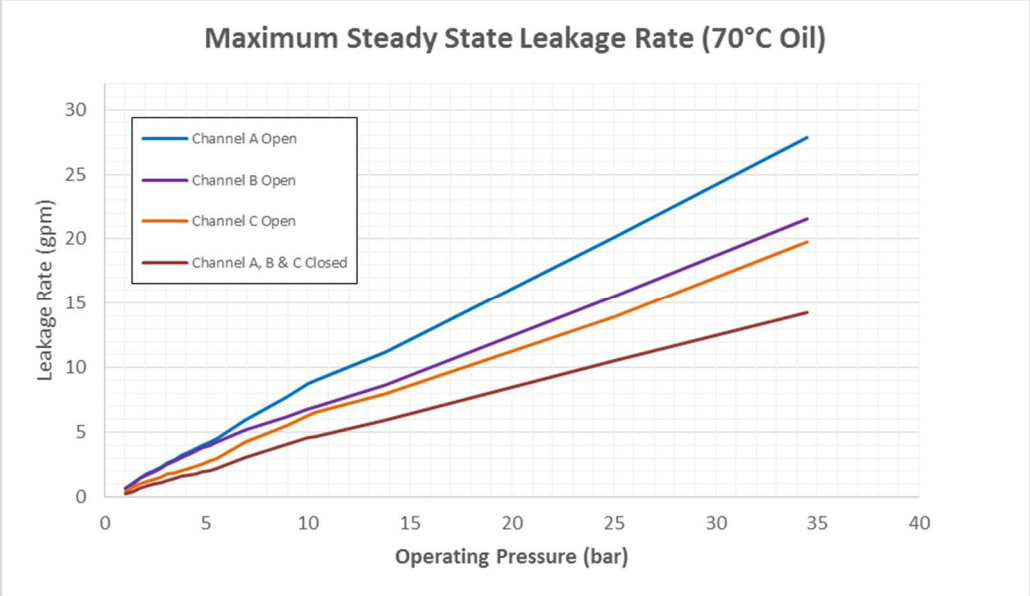

Figure 2-3. QuickTrip Steady State Leakage (70 °C hydraulic oil)

IMPORTANT

The figures above show the maximum expected steady-state leakage flow through the QuickTrip assembly during normal operation. It is important to size the trip system orifice such that the trip header pressure does not fall below the system trip pressure when channel A is open (maximum leakage).

Functional Block Diagram

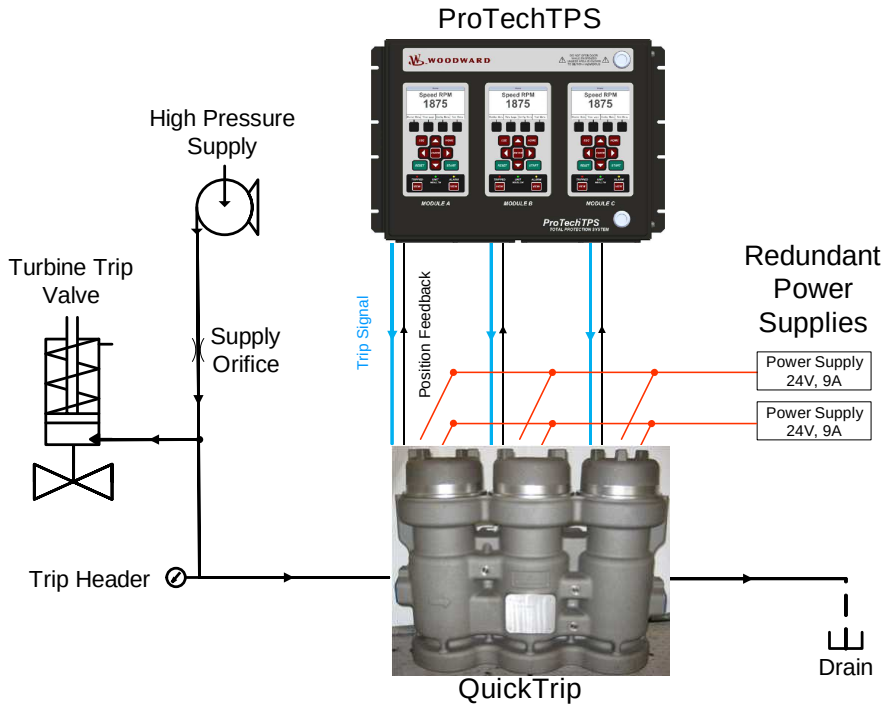

Figure 2-4. Functional Block Diagram

Hydraulic Schematic

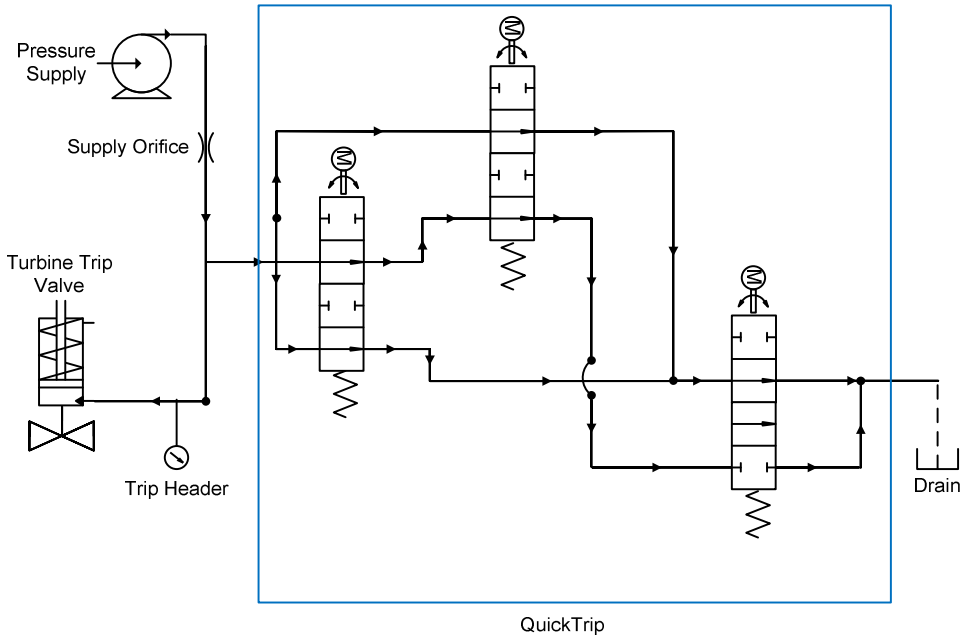

Figure 2-5. Hydraulic Schematic

Outline Dimensions and Installation Features

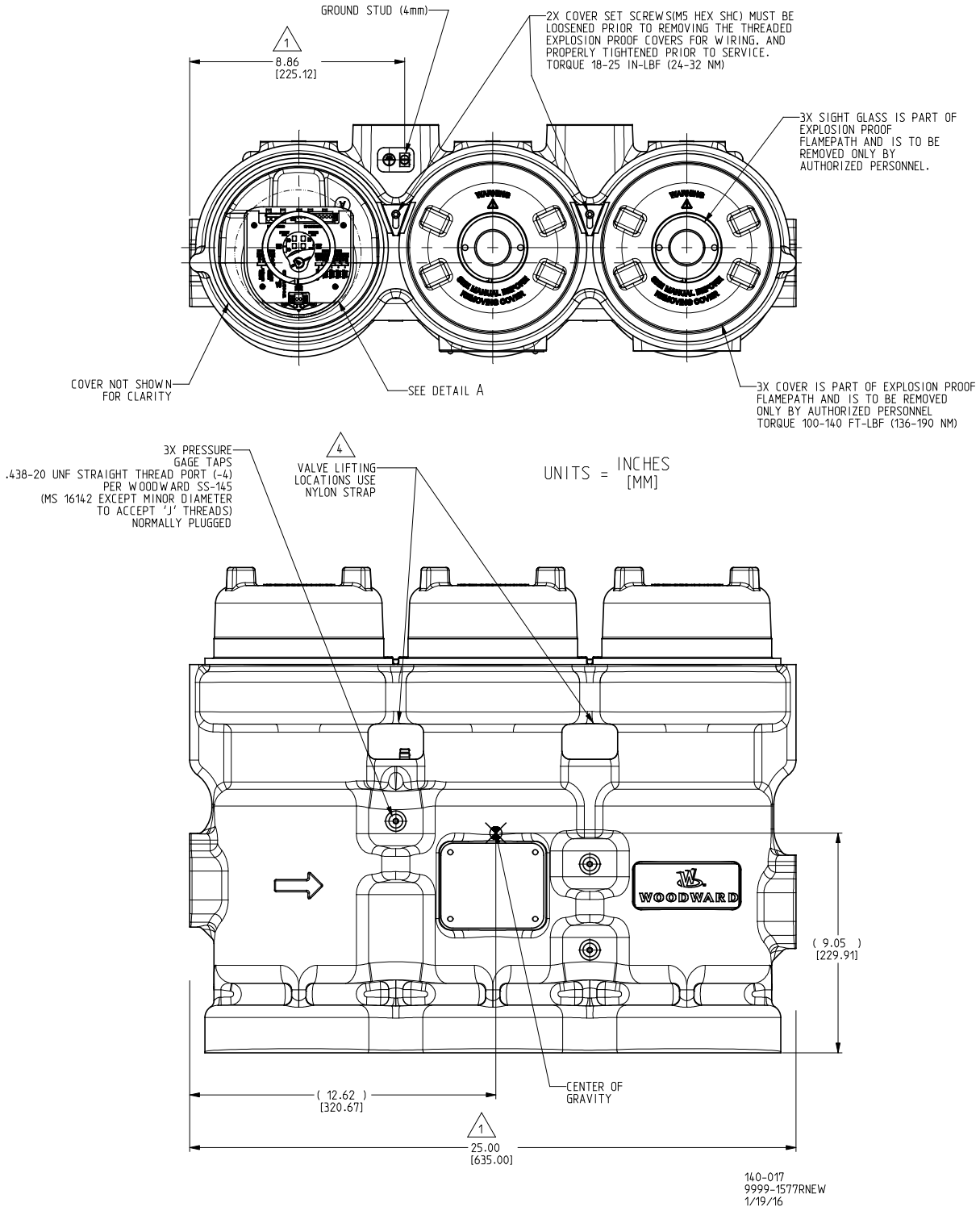

Figure 2-6a. QuickTrip Outline Dimensions

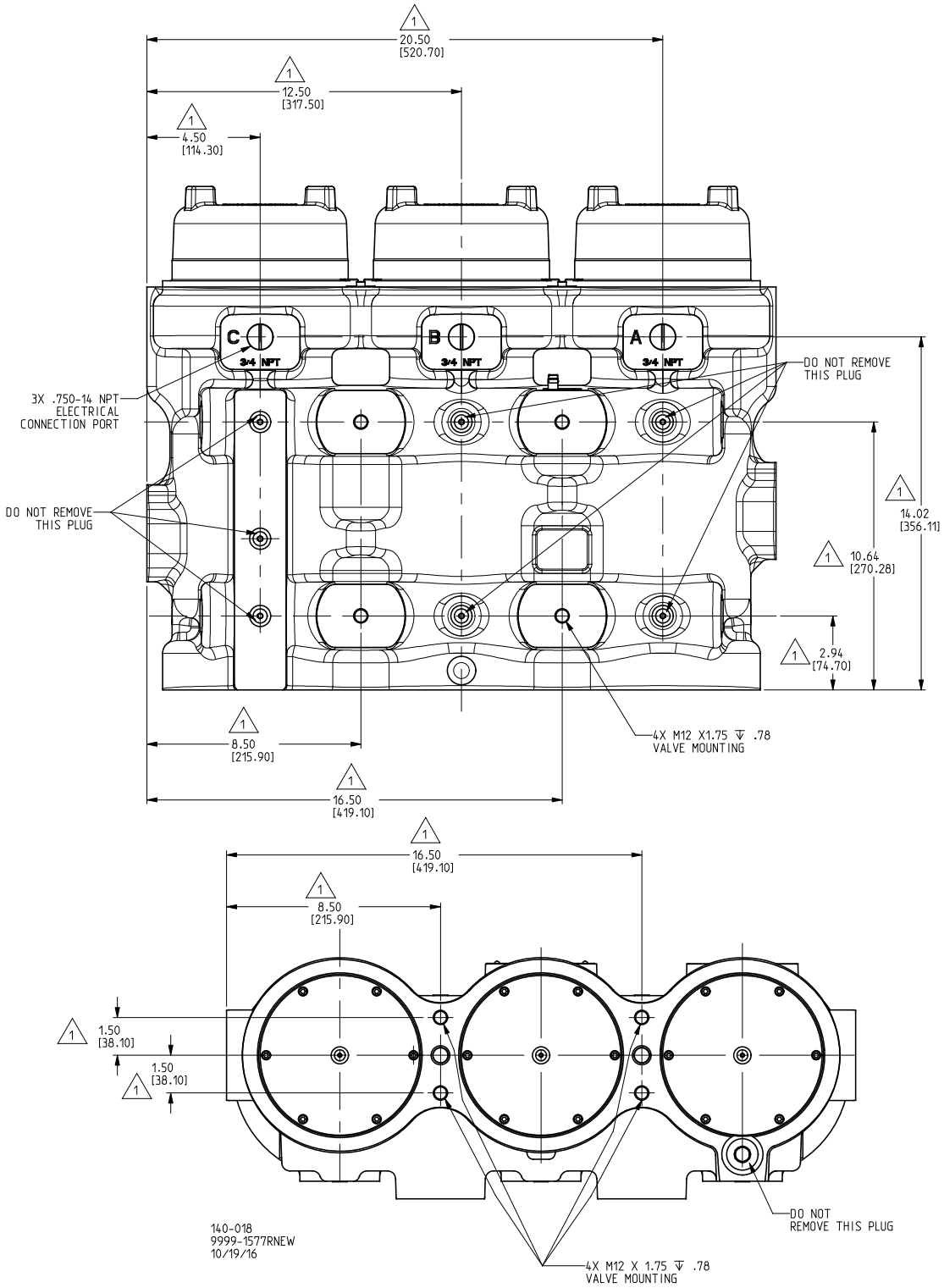

Figure 2-6b. QuickTrip Outline Dimensions

NOTES:

1. FOR FIRST ARTICLE INSPECTION (FAI) REQUIREMENTS, SEE WOODWARD 4-09-2704.
2. THIS IS AN INSTALLATION DRAWING FOR QUICKTRIP, 9907-1248, 9907-TBD.
3. VALVE APPEARANCE MAY VARY FROM SHOWN, AND MAY NOT REFLECT CURRENT HARDWARE.
4. HANG USING BOTH OF THE LIFITING HOLES. SUPPORT VERTICALLY DURING TRANSPORATION.
5. WHEN MOUNTING, MATING SURFACE SHALL BE FLAT TO .020. NO PAINT OR OTHER CONTAMINANTS ALLOWED ON EITHER MATING SURFACES.
6. APPROXIMATE WEIGHT : 243 LBS [110 kg]
7. FOR ANY FURTHER INFORMATION PLEASE SEE MANUAL.

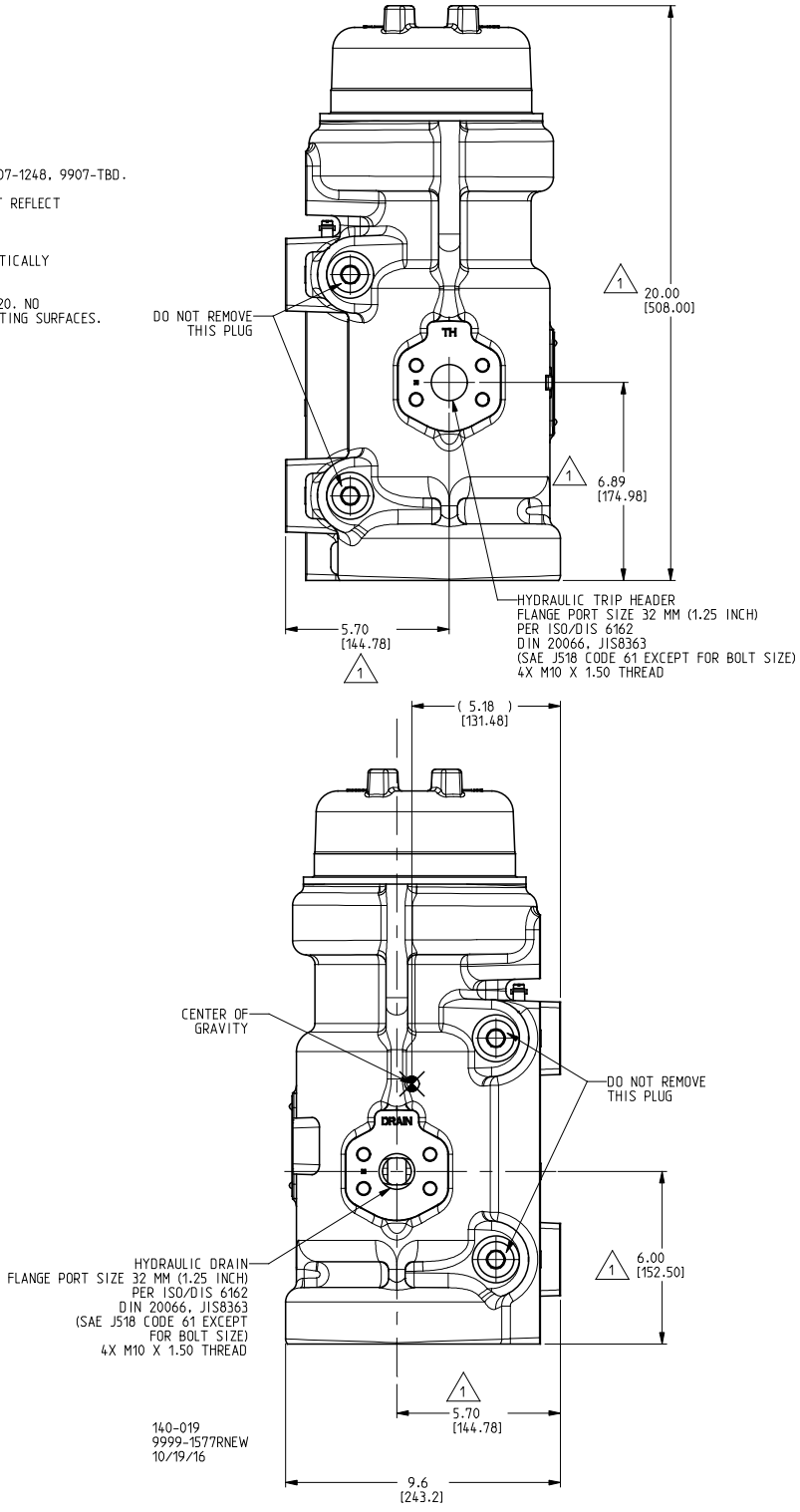

Figure 2-6c. QuickTrip Outline Dimensions

Notes

1. These general reference outline drawings apply to Woodward QuickTrip only. Consult Woodward for the latest outline drawing.

2. Installation Orientation: Orientation vertical approximately as shown See elsewhere in this manual for other installation recommendations.

3. Service Manual Replacement Parts:

- **Product Manual** – Consult Woodward distributor for part number
- **Solenoid** – Consult Woodward distributor for part number
- **Electronics module (PCBA)** – Consult Woodward distributor for part number
- **Return Spring** – Consult Woodward distributor for part number
- **Sight Window** – Consult Woodward distributor for part number
- **Top Cover** – Consult Woodward distributor for part number
- **Bottom Cover** – Consult Woodward distributor for part number
- **Seals Kit(s)** – Consult Woodward distributor for part number
- **Woodward Special Tools Kit** – Consult Woodward distributor for part number

Chapter 3.
Installation

Receiving Instructions

The QuickTrip is carefully packed at the factory to protect it from damage during shipping; however, careless handling during shipment can result in damage. If any damage to the QuickTrip is discovered, immediately notify both the shipping agent and Woodward.

Unpacking Instructions

Carefully unpack the QuickTrip and remove it from the shipping container. Do not remove the hydraulic or electric blanking covers until the unit is ready for mounting.

⚠WARNING

The external ground lug shown on the installation drawing must be properly connected to ensure equipotential bonding. This will reduce the risk of electrostatic discharge in an explosive atmosphere.

⚠WARNING

External fire protection is not provided in the scope of this product. It is the responsibility of the user to satisfy any applicable requirements for their system.

⚠WARNING

Take care not to damage the electronics covers' seals, the covers' surface, threads, or the QuickTrip housing mating surface while removing or replacing the covers.

⚠WARNING

For Zone 1/2 products: Proper torque on all joints is required to ensure that the unit is sealed properly.

⚠WARNING

For lifting and transportation, use lifting straps fitted through both lifting points on the product. Support the QuickTrip in a vertical position during transportation.

⚠CAUTION

Due to typical noise levels in engine and turbine environments, hearing protection should be worn when working on or around the QuickTrip.

⚠CAUTION

The surface of this product can become hot enough or cold enough to be a hazard. Use protective gear for product handling in these circumstances. Temperature ratings are included in the specification section of this manual.

Installation Instructions

General

See the outline drawings (Figure 2-8) and Specifications for:

- Outline dimensions
- Hydraulic connections and fitting sizes
- Electrical connections
- Weight of the QuickTrip

Note: QuickTrip must be mounted in a vertical position (sight windows facing upwards).

Allow space for removal of the top cover for access to the terminal blocks and to see the status LEDs on the printed circuit board.

If the QuickTrip is to be installed in close proximity to un-insulated/un-shielded steam valves or piping, radiation heat shields should be installed between the actuator and these hot surfaces

The QuickTrip is designed for support by one of the two mating surfaces shown in Figure 3-1. For the mating surface bolt patterns, threads, and torques, the recommendations in Table 3-1 must be followed.

Table 3-1. QuickTrip Product Installation Interface

Thread	Thread Size	Dim. A [mm]	Dim. B [mm]	Min Thread Engagement [mm] (in)	Min. Bolt Grade	Bolting Torque [N·m] (lbf-ft)	Bolt Tol. Class
”A”	M12x1.75	203.2	195.58	[18] (0.71)	8.8	[47-54] (35-40)	6g
“B”	M12x1.75	203.2	76.2	[18] (0.71)	8.8	[47-54] (35-40)	6g

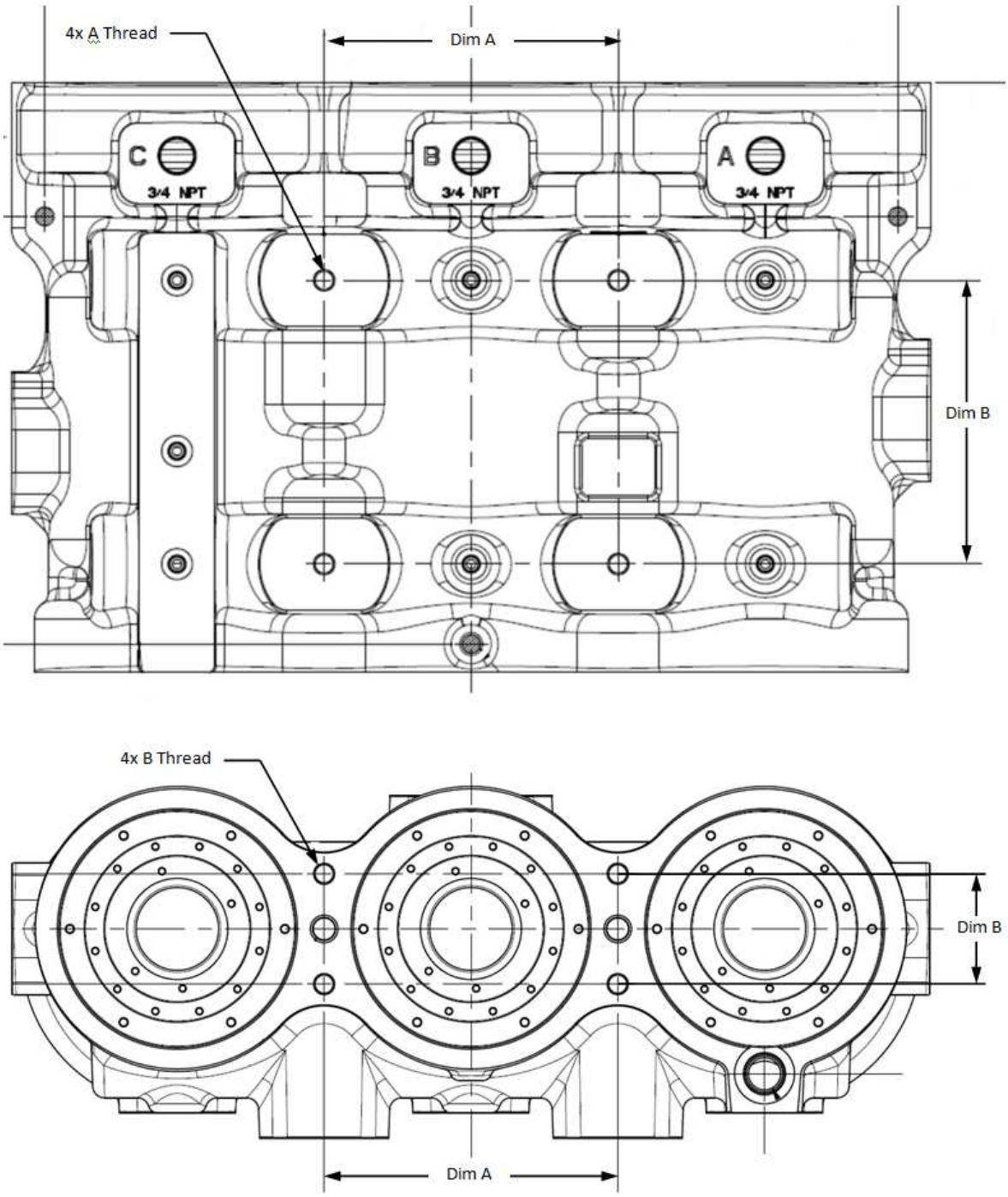

Figure 3-1. QuickTrip Product Installation Interface—Bolting Pattern

NOTICE

Minimum Bolt Grade, Bolting Torque and Thread Engagement Recommendation is valid for low carbon steel mounting surfaces to which product is bolted. For different configurations please consult Woodward for torque and bolt grade recommendations.

⚠WARNING

The QuickTrip is designed for support by the two mounting surfaces and bolt holes shown. Additional supports are neither needed nor recommended.

Any mounting deviation from the one recommended by Woodward might cause assembly damage, improper performance or operator injury risk.

Improper mounting might be considered as a violation of warranty conditions.

⚠WARNING

QuickTrip lifting is allowed ONLY by using two provided strap loops. During transportation, the QuickTrip may be supported in either the vertical or horizontal orientation. Do not lift or handle the QuickTrip by any conduit.

⚠WARNING

Ensure that the crane, cables, straps, and all other lifting equipment used for QuickTrip lifting is able to support the QuickTrip weight. See outline drawings for QuickTrip weight.

Hydraulic Connections

The QuickTrip has two hydraulic connections that must be made to supply and drain.

The QuickTrip actuators uses:

- 1.250 SAE J518 Code 61 Flange for Hydraulic Supply Port
- 1.250 SAE J518 Code 61 Flange for Hydraulic Drain Port

(Note: SAE J518, JIS B 8363, ISO/DIS 6162 AND DIN 20066 are interchangeable, except for bolt sizes. QuickTrip uses a metric bolt size.)

Hydraulic connection tightening torques:

- Hydraulic Supply:
  4x M10x1.5 Screws Torque to 34 to 48 N·m, (25 to 35 lbf-ft)
- Hydraulic Drain:
  4x M10x1.5 Screws Torque to 34 to 48 N·m, (25 to 35 lbf-ft)

⚠CAUTION

Before installing the QuickTrip, all hydraulic lines must be thoroughly flushed.

Make provisions for proper filtration of the hydraulic fluid that will supply the QuickTrip. The system filtration should be designed to assure a supply of hydraulic oil with a target cleanliness level of ISO 4406 code 20/18/16 or cleaner. A filter of size 20 micron or smaller is recommended with a beta ratio of at least 200 (95.5% efficiency) in order to prevent large particles (50 microns or larger) from entering the QuickTrip valves.

The tubing connected to the actuator must be constructed to eliminate any transfer of vibration or other forces to the actuator.

The hydraulic supply and drain to the QuickTrip are to be at least 25 mm (1 inch), or larger, tubing capable of flowing up to 908 L/min (240 US gal/min) at 34.5 bar / 500 psig.

The drain pressure must not exceed 10% of trip header pressure or 3.4 bar (50 psig), whichever is less, under any condition.

Pipe diameters to both the Supply and Drain connections should be maximized, within reason, to ensure that flow losses and restrictions are minimized. For the same reason, pipe lengths should be kept to a minimum.

WARNING

Do not remove any test port connection plugs when hydraulic supply pressure is applied. All required hydraulic connections must be made before hydraulic pressure is applied. Hydraulic test ports provided for use by authorized service personnel only.

Electrical Connections

An overall electrical wiring diagram is shown in Figure 3-3. Detailed wiring requirements for these connections will follow in the remainder of the Electrical Connections section.

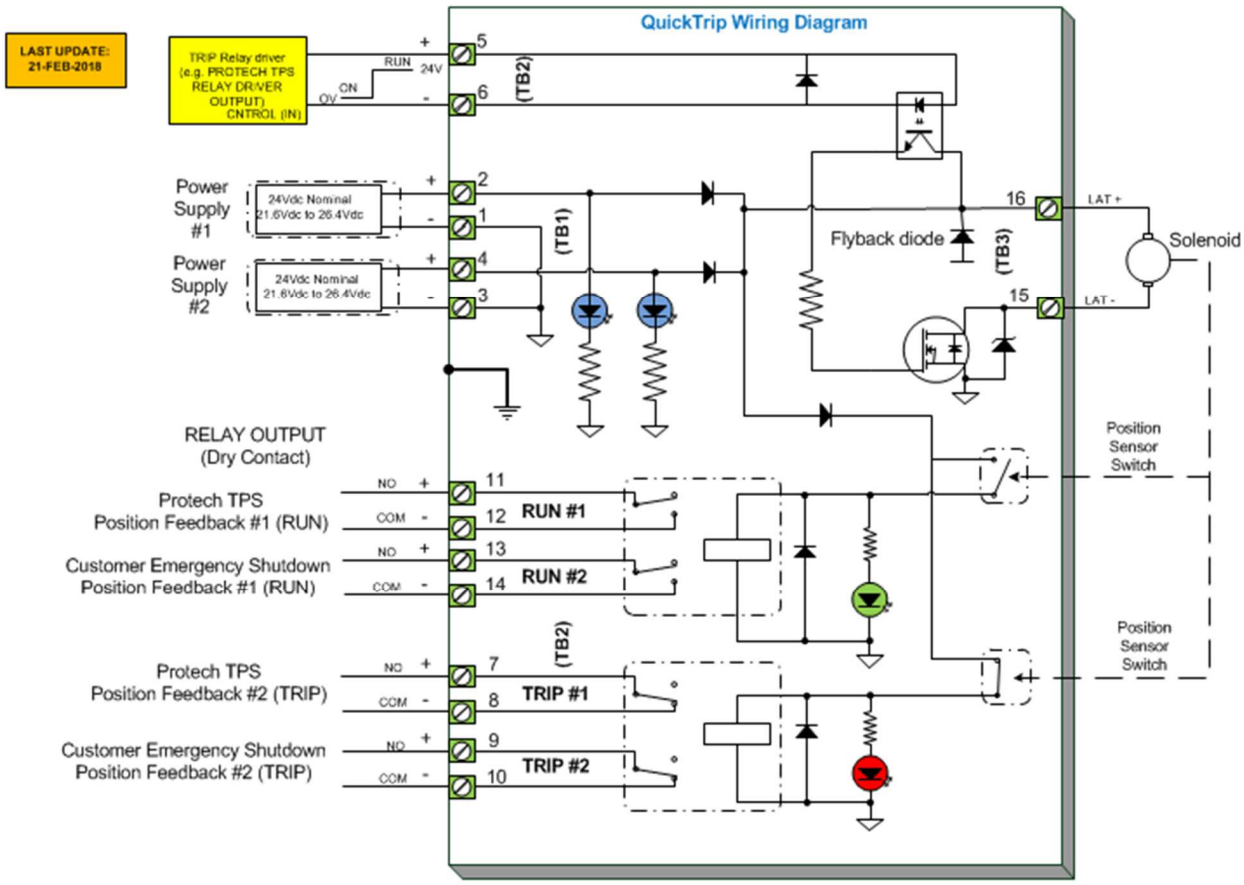

Figure 3-2. Electrical Wiring Diagram

Input Power

The QuickTrip requires a power source capable of a supplying the necessary output voltage and current at full transient conditions. The maximum power in watts (W) of a DC source can be calculated by multiplying the rated output voltage by the maximum output current capability. The calculated power rating of the supply should be greater than or equal to QuickTrip requirements. The electrical power supply should be able to provide 8 A (or 2.6 A per channel) at 24 Vdc continuously, with a peak of 10 A for 100 milliseconds.

Cable selection and sizing are very important to avoid power loss during operation. The power supply input at the electronic module input terminal must always provide the required nominal voltage to operate the valve.

The input power wires must comply with local code requirements and be of sufficient size such that the power supply voltage minus the IR loss in the two lead wires to the QuickTrip valve electronics module does not drop below the input minimum voltage requirement.

The QuickTrip is not equipped with an input power disconnect. A means of disconnecting input power to the QuickTrip must be provided for safe installation and servicing.

The QuickTrip is not equipped with input power protection. A means of protecting input power to the QuickTrip must be provided. Breakers or fuses are intended to protect installation wiring and power sources from faults in the QuickTrip or wiring. A circuit breaker meeting the requirements from the table below, or a separate protection with the appropriate ratings, may be used for this purpose.

Refer to the table below for recommended fuse ratings or circuit breakers.

Table 3-2. Recommended Circuit Breaker Fuse Ratings

Component	Input Voltage	Steady State Input Current (per module)	Maximum Transient Input Current (all modules)	Maximum Power	Maximum Slow Blow Fuse / C.B. Rating
QuickTrip	(21.6-26.4) Vdc 24 Vdc nominal	2.6 A @ 24 Vdc	10 A	280 W (100 ms)	20% above Steady State Current

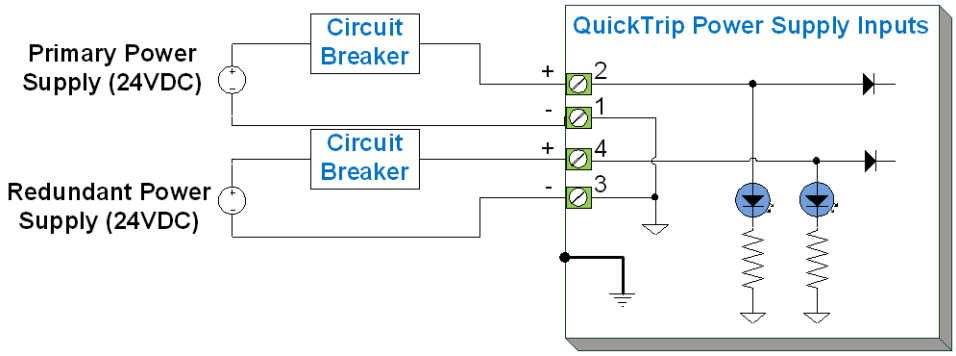

Figure 3-3. Power Supply Input Connections

The QuickTrip is capable of connecting two redundant power supplies to each valve electronics module. The following table presents terminal assignment for this option usage.

Table 3-3. Power Supply Input Terminals

	Power Input (+)	Power Input (-)
Power Supply #1	Terminal # 2	Terminal # 1
Power Supply #2	Terminal # 4	Terminal # 3

WARNING

If redundancy option is not used, both (+) signals (Terminal #2 and Terminal #4) should be connected together at the terminal.

Although the QuickTrip is protected against input voltage transients, good wiring practices must be followed. The following drawings illustrate correct and incorrect wiring methods to the power supply.

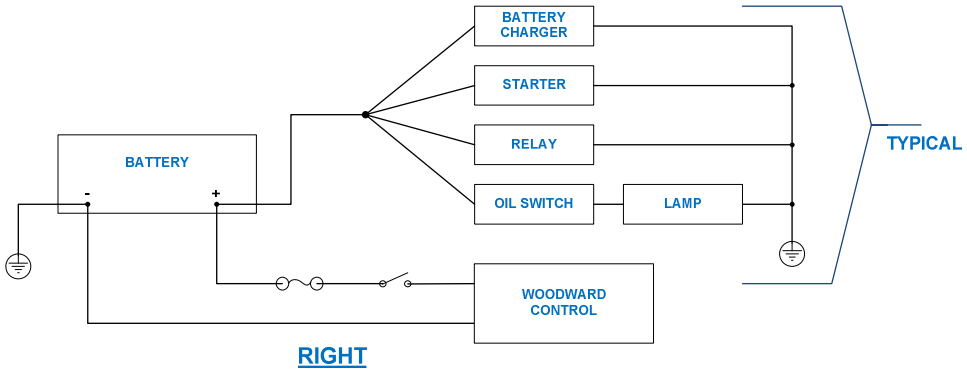

Figure 3-4. Correct Wiring to Power Supply Input

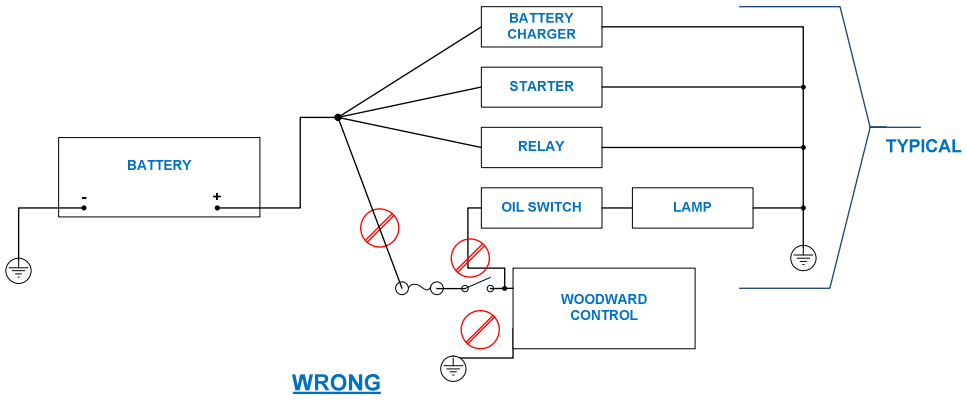

Figure 3-5. Example of Incorrect Wiring to Power Supply Input

Power Wiring Requirements:

- Keep these inputs separated from low level signals to reduce signal noise
- Wire Gauge minimum Requirements: 0.8 mm² / 18 AWG
- Maximum Wiring Distance: 30 m

Unit Grounding

The unit housing must be grounded using the designated PE ground connection point (see Figure 2-8a).

For the PE connection, use required type (typically green/yellow, 3.3 mm² / 12 AWG) as necessary to meet the installation safety ground requirements. Torque the ground lug to 1.7-2.3 N·m (15-20 in-lbf).

IMPORTANT **In cases where the EMC ground configuration also meets installation safety ground requirements, no additional PE ground is required.**

Wiring Strain Relief

Tie down points and ratcheting tie wraps are provided to secure the wiring to the PCB mounting plate. This helps prevent wire strain from being transmitted to the connection at the terminal block and to keep the wiring from chafing on the cover when tightening and under vibration. Failure to secure the wiring could result in intermittent connections resulting in intermittent operation or shutdown conditions. Additional wire service length should be allowed between the tie down points and the connectors to reduce strain on the wire at the connector interface and to allow removal of the black pluggable connector.

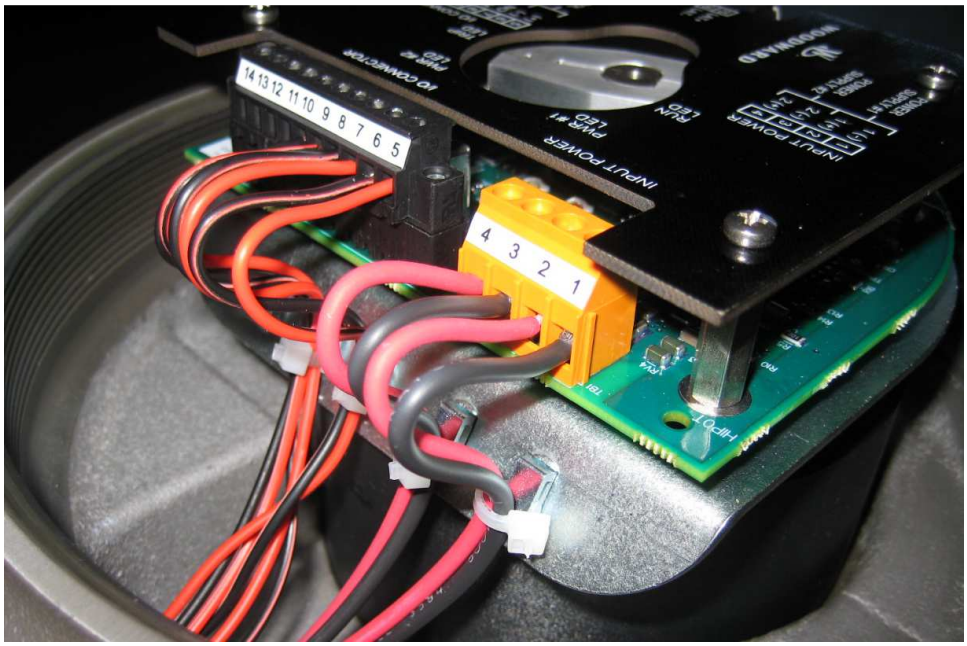

Figure 3-6. Recommended Wiring Strain Relief

Shield Installation Notes

- Wires exposed beyond the shield should be as short as possible, not exceeding 50 mm (2 inches).
- The shield termination wire (or drain wire) should be kept as short as possible, not exceeding 50 mm (2 inches), and where possible the diameter should be maximized.
- Installations with severe electromagnetic interference (EMI) may require additional shielding precautions. Contact Woodward for more information.
- Do not ground shield on both ends, except where permitted by the control wiring diagram.

Failure to provide shielding can produce future conditions which are difficult to diagnose. Proper shielding, at the time of installation is required to ensure satisfactory operation of the product.

Control Input

The QuickTrip valves are controlled with the independent trip relay outputs from a trip system logic solver such as the Woodward ProTechTPS.

> **Note**: When used with the ProTechTPS, external power is not necessary for these inputs. All voltage and isolation is provided within the ProTechTPS (24 Vdc, 0.5 A).

Trip Points:

- If the Input voltage drops below14 Vdc, then the input will detect a Trip state.
- If the Input voltage rises above 15 Vdc, then the input will detect a Run state.

Control Input Isolation: 500 Vac from Input to chassis.

The following table presents terminal assignment for the control input.

Table 3-4. Control Input Terminals

Control Input	Control In (+) Terminal # 5	Control In (-) Terminal # 6

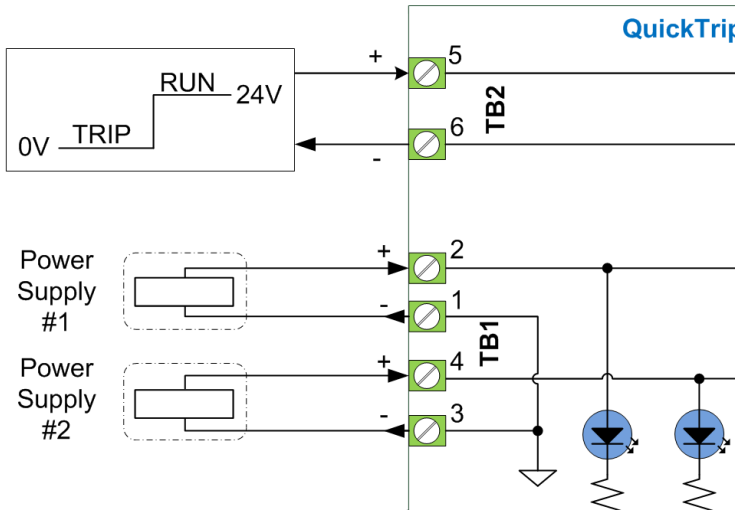

Figure 3-7. Control Input Connections

Wiring Requirements

- Keep this and all other low level signal cables separated from input power cables to avoid unnecessary coupling (noise) between them.
- Wire Gauge Range: 0.8 to 1.3 mm² / 16 to 28 AWG stranded wire.
- Shielding: The Control Inputs are unshielded; however, the wires should be kept in a twisted configuration for noise immunity.

Position Feedback

There are two outputs for valve position feedback on each of the QuickTrip's three valve modules (12 outputs total). Each of the two outputs features redundant connections. Both TRIP outputs and both RUN outputs operate as normally open. The outputs can be wired to either switch load from positive supply or switch load to ground. The user must supply the external 24 V supply for the output to function properly. If using the Woodward ProTech TPS logic solver, the voltage may be supplied using the on-board discrete power terminals (24 Vdc, 0.050 A).

Table 3-5. Feedback Voltage Specifications

External Power Supply Voltage Range:	0-28 V
Maximum Load Current:	2 A
Response Time:	Less than 10 ms
On-state Voltage drop:	Less than 100 mV @500 mA
Isolation:	500 Vac from digital ground to chassis

The following table presents terminal assignment for the control input.

Table 3-6. Feedback Terminals

	Trip/Run (NO)	Trip/Run (Com)
Trip # 1 Out	Terminal # 7	Terminal # 8
Trip # 2 Out	Terminal # 9	Terminal # 10
Run # 1 Out (optional)	Terminal # 11	Terminal # 12
Run # 2 Out (optional)	Terminal # 13	Terminal # 14

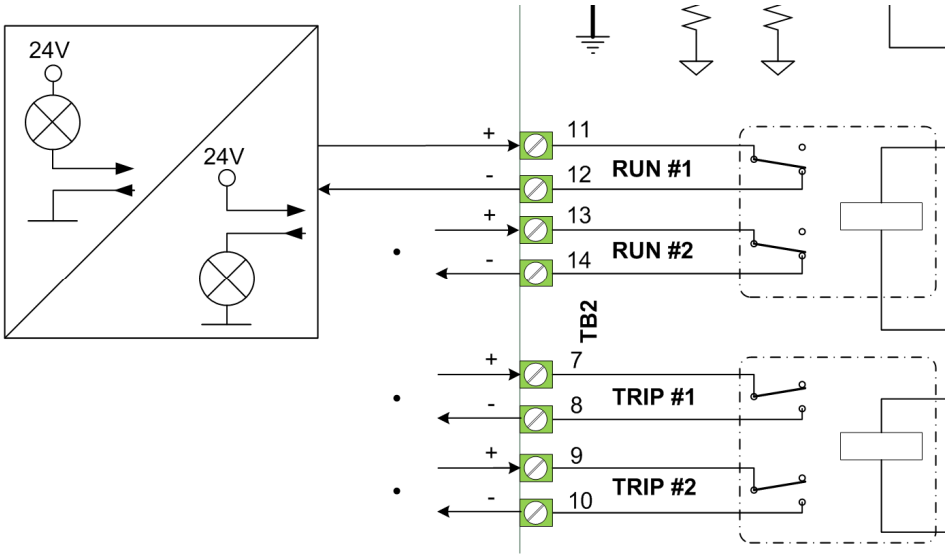

Figure 3-8. Feedback Output Connections

Wiring Requirements:

- Keep this and all other low level signal cables separated from input power cables to avoid unnecessary coupling (noise) between them.
- Wire Gauge Range: (0.8 to 1.3) mm² / (16 to 18) AWG
- Shielding: these outputs are unshielded, however the wires should be kept in a twisted configuration for noise immunity.

Wiring

The QuickTrip has three, 3/4 inch (19 mm) NPT wiring entries.

When using cable and cable glands, the gland fitting must meet the same hazardous locations criteria as the QuickTrip. Follow all installation recommendations and special conditions for safe use that are supplied with the cable gland. The cable insulation must have a temperature rating of at least 85 °C and 10 °C above the maximum ambient and fluid temperature.

Strip the cable insulation (not the wire insulation) to expose 12 mm (1/2 inch) of the conductors. Strip the wire insulation 5 mm from each conductor. Mark wires according to their designation and install connectors, if required.

Remove the top access cover(s). Pass the wires through the cable gland (not provided) or conduit fitting and attach wires to the printed circuit board terminal blocks in accordance with the wiring diagram. Secure each wire into connector terminal using a 2.5 mm flat screwdriver blade, applying a torque of 0.2-0.25 N·m (1.75-2.25 in-lbf). Snap the terminal blocks into the header terminal blocks on the PCB. Tighten the terminal block flange screws to 0.5 N·m (4.4 in-lbf). Replace the top access cover and torque it using a 1 meter bar or wrench; tightening until the O-ring seal is compressed and the cover is fully seated against the housing.

Tighten the cable gland fitting per manufacturer's instructions or pour the conduit seal to provide strain relief for the cable and to seal the interface between the wiring cable and the QuickTrip modules.

In order to preserve the QuickTrip's online reparability, each of the three electrical actuator cavities must be kept isolated from each other. This allows any individual actuator requiring repair to be electrically de-energized, repaired and placed back online while maintaining safe operation of QuickTrip in potentially explosive environments.

⚠WARNING

Failure to isolate each QuickTrip actuator cavity from the environment and from each other may result in an unintended explosion hazard.

Once all wiring is complete, carefully thread the top electronics cover onto each actuator cavity, being careful not to cross-thread them. Thread the covers all the way down by hand, and then torque them to 136-190 N·m (100-140 ft-lbf). Woodward tool 1013-6603 can be used to torque the cover.

⚠WARNING

Take care not to damage the electronics' cover seal, the cover surface, the threads, or the QuickTrip housing mating surface while installing the cover.

⚠WARNING

Proper wiring

Due to the hazardous location listings associated with this product, proper wire type and wiring practices are critical to operation.

Once all covers are in place, install the two cover clamps to secure the covers in place. The clamps must engage the lip of each cover to prevent the covers from unintentionally coming loose (ex. due to vibration). Torque the two screws to 24-32 N·m (18-24 (in-lbf). See Figure 3-7 Below.

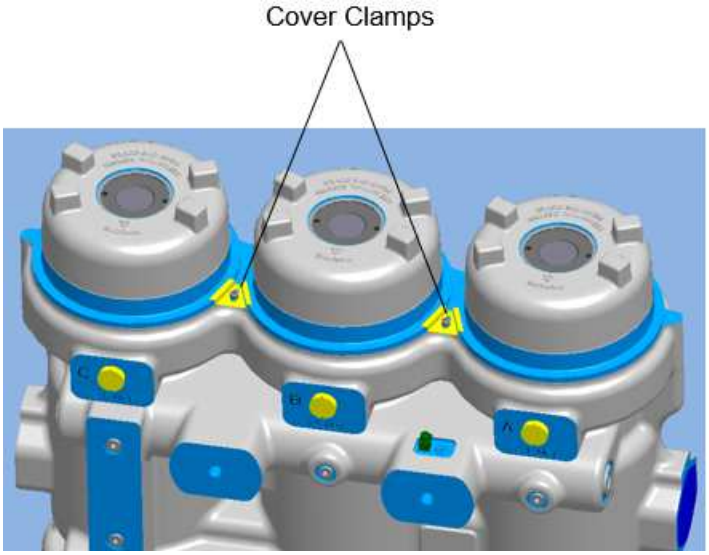

Figure 3-9. Cover Clamps

⚠WARNING

Failure to install the cover clamps may allow the electronics covers to unintentionally loosen, and may result in an unintended explosion hazard.

NOTICE

Do not connect any cable grounds to "instrument ground", "control ground", or any non-earth ground system. Make all required electrical connections based on the wiring diagrams.

WARNING

ELECTRIC SHOCK—To reduce the risk of electric shock, Protective Earth (PE) must be connected to the termination point on the top of the unit next to the label with the ⏚ symbol.

The conductor providing the connection must have a properly sized ring lug and wire gauge larger than or equal to 4 mm² (12 AWG). The ring lug should be placed between the nut and star washer.

The calibration and checkout procedure should only be performed by authorized personnel. To be authorized personnel, personnel must be knowledgeable of the risks posed by live electrical equipment.

Chapter 4.
Operation

Operating QuickTrip

Each QuickTrip consists of three independently operated modules referred to as A, B and C. Each module accepts two redundant power inputs, one control signal input (to energize or de-energize the actuator) and includes two trip feedback outputs (for de-energized/valve open state) and two run feedback outputs (for energized/valve closed state). A logic solver, such as the Woodward ProTechTPS or MicroNet Safety Module, is required to provide the control input signal and to monitor the feedback outputs. The QuickTrip is a SIL-3 (according to IEC-61508) triple modular design that operates in a two-out-of-three voting logic method. This means the QuickTrip will continue to function normally even if one module is not operating correctly. It also means any module can be repaired online while the turbine is on-line and operating normally.

Operation with ProTechTPS

QuickTrip is designed for use with a logic solver such as the Woodward ProTechTPS or MicroNet Safety Module. If another logic solver is used, consult that manufacturer's user's manual for instructions for interface, configuration and operation with QuickTrip. This section provides an overview of operating the QuickTrip with ProTechTPS. For more detailed information, please consult the ProTechTPS product manual.

Energizing QuickTrip Modules

With no alarm conditions present, any QuickTrip module can be energized by pressing the "RESET" button on the ProTechTPS front panel. This places QuickTrip into a run mode (valves closed).

Tripping QuickTrip modules

Any QuickTrip module can be individually tripped by performing a simulated speed test (manual or auto). These tests can be accessed through the ProTechTPS front panel display by pressing "Test Menu". Refer to ProTechTPS manual 26501V2, Chapter 11 for additional information.

Performing Auto-Sequence Test (Periodic Overspeed Test)

Since QuickTrip is a critical part of the turbine overspeed safety system, it is important to perform a regular Auto-Sequence Test in order to verify unit health and to take advantage of the diagnostic coverage provided by this test. The Auto-Sequence Test initiates an automated and sequential test of each individual module and can be performed without interrupting turbine operation. The test begins with ProTech Module A automatically ramping up the module's internal frequency generator until it exceeds the overspeed set point at which time the control signal is interrupted and the QuickTrip module trips. Then, this module resets and the test is repeated, sequentially, on modules B and C. Refer to ProTechTPS manual 26501V2, Chapter 11 for additional information.

The Auto-Sequence Test can be accessed through the ProTechTPS front panel display by pressing "Test Menu", then "Auto-Sequence Test". This test should be configured to run automatically by enabling the Periodic Test Timer (set to "YES"). The Periodic Test Timer Interval should also be set. This interval can be configured for intervals ranging from 1 to 999 days. Woodward recommends this interval be set between 1 and 3 days in order to continually ensure QuickTrip health and to maintain its reliability when used with dirty hydraulic oil. Refer to ProTechTPS manual 26501V2, Chapters 10 and 11 for additional information.

An assumed MTTR (meant time to restoration) according the test interval (for on-line testing, 72 h, 48 h and 24 h) + 8 h of MRT (mean repair time).

View Trip Log

The trip log displays a log of any trip events. The trip log can be accessed by pressing the “VIEW” button directly underneath the “TRIPPED” LED indicator on the ProTechTPS front panel. Refer to ProTechTPS manual 26501V2, Chapter 9 for additional information.

View Alarms

The alarm log displays a log of any alarm events that may or may not have resulted in a trip event. The alarm log can be accessed by pressing the “VIEW” button directly underneath the “ALARM” LED indicator on the ProTechTPS front panel. Refer to ProTechTPS manual 26501V2, Chapter 9 for additional information.

Manually Monitoring Trip Cycle Time Log

ProTech can be configured to monitor the trip time for each QuickTrip module (see below). This trip time can be checked through the ProTechTPS front panel display by pressing “View Logs”, then “Trip Cycle Time Log”. This log displays the last 20 trip events and the time from when the control signal was dropped to the time the QuickTrip valve rotated to the open position and the trip position sensor annunciated a trip signal back to ProTech. Refer to ProTechTPS manual 26501V2, Chapters 9 and 11 for additional information.

Configuration Options

In order to detect certain failure modes and provide diagnostic coverage for the QuickTrip, the following configuration recommendations are provided.

1. Trip Time Monitor
   Since QuickTrip is a critical part of the turbine overspeed safety system and needs to perform its safety function quickly, it is important to continuously monitor the trip time to ensure it remains below a certain threshold. Woodward recommends a threshold of 100 ms, but the installation site should set this value such that the entire safety system performs is function within a safe timeframe. The Trip Cycle Time Monitor can be accessed through the ProTech “Monitor” Menu. Refer to ProTechTPS manual 26501V2, Chapter 9 for additional information.

2. Trip Alarm
   ProTech should be configured to annunciate an alarm when any QuickTrip module annunciates a tripped state (through the trip feedback circuit). This will provide early warning for a QuickTrip module that fails to remain in a run state (valve fails to remain closed) when the turbine is running. Refer to ProTechTPS manual 26501V2, Chapters 9 and 11 for additional information.

3. Run Alarm (optional)
   ProTech may be configured to detect an event where the ProTechTPS module is commanded to a run state, but QuickTrip fails to annunciate a run state (through the run feedback circuit) within a certain timeframe (Ex. 5 sec). This configuration is optional, but may provide early warning for a QuickTrip module that fails to energize to a run state (valve fails to close) when commanded to do so. Refer to ProTechTPS manual 26501V2, Chapters 9 and 11 for additional information.

4. Power Failure Alarm
   With input power properly applied to any QuickTrip module, that module will normally annunciate either a run or a trip signal since the valve for that module will either be in a run or trip state. If no run or trip signal is annunciated, then the power supplies that power QuickTrip may not be functioning. The run and trip position switches actuate normally open relays that are operated by the same power supplies that power the QuickTrip module. Without these power supplies, both relays and both trip and run position annunciation outputs revert to normally open (Refer to Figure 3-2). ProTechTPS may be configured to detect the case where one (if only one PS is used) or both power supplies fail to provide power to any QuickTrip module. In this case, the ProTechTPS would be configured to annunciate an alarm if both the run and the trip feedback are inactive (open) for some amount of time (Ex. 5 seconds). Note that when the valve changes position and travels from closed to open or from open to closed, both feedbacks will be momentarily open since the valve is in motion from one state to another and is not actuating the trip or the run position switch during the time the valve is moving. Also note that, if the power supplies are not functioning, the two blue LED's on the electronics module (PCBA) will also not be lit (see Valve Position Feedback below). Reference ProTechTPS manual 26501V2, Chapter 11 for additional information.

Valve Position Feedback

There are three methods by which to determine the position of any QuickTrip module valve element:

The position feedback circuits, actuated through the valve position sensors (ref wiring diagram in Figure 3-2).

1. When any QuickTrip module is in a tripped state (de-energized, valve open), the trip position sensor switch is actuated, energizing a relay that closes the trip feedback circuits*. At the same time, the red trip LED is on (see LED lamps below)*.
   - When any QuickTrip module is in a run state (energized, valve closed), the run position sensor switch is actuated, energizing a relay that closes the run feedback circuits*. At the same time, the green run LED is on (see LED lamps below)*.
2. The LED lamps on the electronics module (PCBA), visible through the sight window in the top of the electronics cover.
   - When any QuickTrip module is in a tripped state (de-energized, valve open), the red trip LED is on*.
   - When any QuickTrip module is in a run state (energized, valve closed), the green run LED is on*.

   Note: The QuickTrip module must also be connected to an active power source (reference Figure 3-3).

3. The pressure ports on the front of the QuickTrip manifold.
   - While the position feedback circuits and LED's are the preferred method to determine module valve position, three pressure ports are provided on the front of the QuickTrip unit. These may be connected to pressure gages or pressure transducers and may be used to determine the state of any module valve element. The image in Figure 4-1 below shows these pressure ports. Note that Pressure Port B is not used. These ports are for standard dash-4 straight thread port fittings (7/16-20 thread size).

⚠WARNING

Do not remove any test port connection plugs when hydraulic supply pressure is applied. All required hydraulic connections must be made before hydraulic pressure is applied. Hydraulic test ports provided for use by authorized service personnel only.

   - The following logic table shows the approximate pressure that can be expected at each pressure port for any QuickTrip state where only one valve is open.

Table 4-1. Pressure Port Logic Table

	Pressure Port A	Pressure Port B	Pressure Port C
All Valves Closed	≈45% P1*	(not used)	≈50% P1*
Module A Valve Open	=P1*	(not used)	=P1*
Module B Valve Open	= drain pressure	(not used)	=P1*
Module C Valve Open	≈50% P1*	(not used)	= drain pressure

* P1 is equal to the Trip Header Pressure at the inlet to QuickTrip

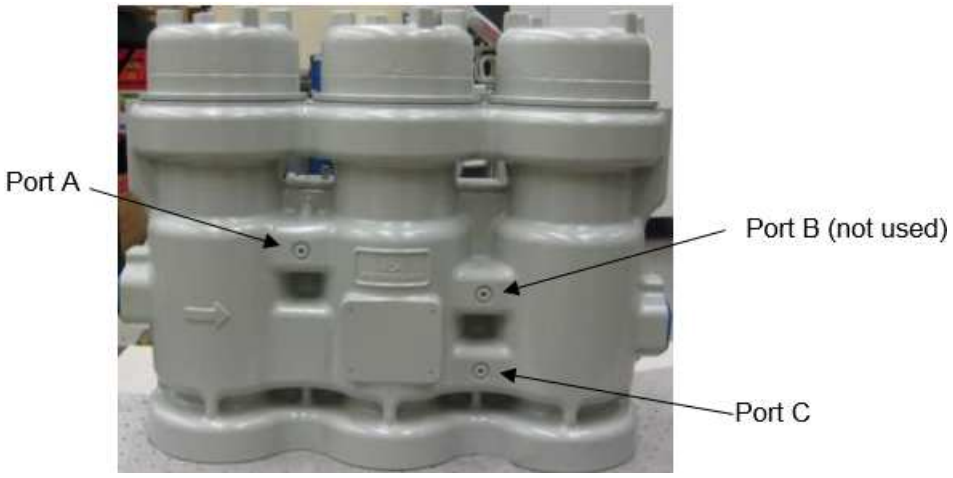

Figure 4-1. Pressure Test Ports

Special Ambient Temperature Considerations

Cold Start Procedure:

If performing a cold-start of QuickTrip in very cold ambient environment conditions (temperatures between -40 °C to +15 °C), both the hydraulic oil within the QuickTrip manifold and the QuickTrip manifold itself must undergo a warmup procedure prior to starting the turbine to ensure the QuickTrip will operate within specified performance limits. In particular, slew open times increase at lower hydraulic fluid temperatures due to the higher viscosity (lower fluidity) of the hydraulic oil.

Before starting the QuickTrip, follow the warm-up procedure below:

1. De-energize all QuickTrip modules (valves should be open)
2. Start flow of warm hydraulic fluid through QuickTrip such that the temperature of the oil flowing from the drain side of QuickTrip is at or above +15 °C.
3. Allow the warm hydraulic fluid to flow through QuickTrip for at least 30 minutes, while maintaining the temperature at the drain side of QuickTrip at or above +15 °C.
4. Energize all QuickTrip modules
5. Use the ProTechTPS to run an auto sequence test on QuickTrip (sequentially de-energizing and re-energizing each channel individually)
6. After the auto sequence test is complete, check the trip time log and verify each QuickTrip module tripped in less than 50 ms.
7. If QuickTrip is to be operated continuously in very cold ambient environment conditions, the hydraulic oil temperature flowing from the drain side of QuickTrip must be continuously maintained above +15 °C.
8. Alternate methods of heating/insulating the QuickTrip and the hydraulic fluid lines upstream from QuickTrip in very cold ambient environment conditions are recommended and might include the use of heat tape, heat blankets and insulation.

Chapter 5.
Repair and Troubleshooting

⚠WARNING

To prevent possible serious personal injury, or damage to equipment, be sure all electric power and hydraulic pressure have been removed from the QuickTrip before beServoginning any maintenance or repairs.

⚠WARNING

Due to typical noise levels in turbine environments, hearing protection should be worn when working on or around the QuickTrip.

General

Woodward Products covered under Woodward Product and Service Warranty (5-01-1205) are warranted to be free from defects in materials and workmanship, when installed and used in the manner for which they are intended, for a period of 18 months from the date of shipment from Woodward.

Repairs and servicing of the QuickTrip must be performed by Woodward or its authorized service facilities

Use of a cable gland or stopping plug that does not meet the hazardous area certification requirements or thread form or thread size will invalidate the suitability for hazardous locations.

Never remove or alter the nameplate as it bears important information which may be necessary to service or repair the unit.

QuickTrip Cover Replacement Kit

Servo cover replacement kit may be ordered from Woodward.

Refer to Figure 5-1a which displays the part number. The location and assembly orientation of each kit component must be installed as depicted in Figure 5-1b using a spanner wrench or Woodward tool #1013-6603. For additional information see QuickTrip Field Repair Procedure Manual 26842.

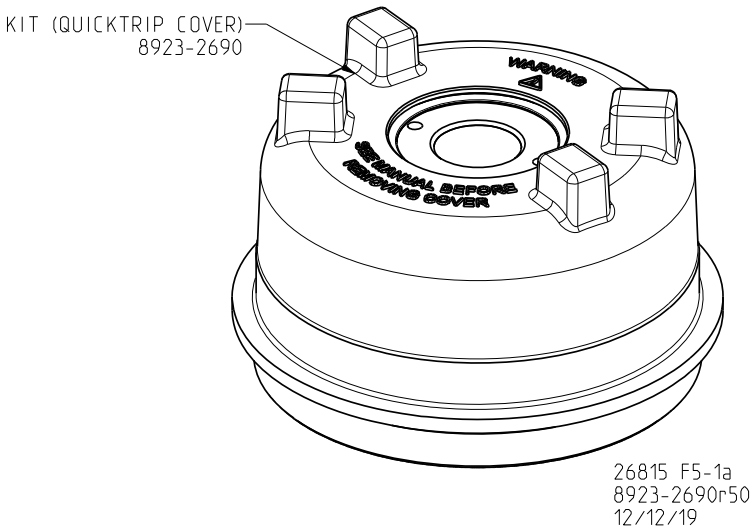

Figure 5-1a. Servo Cover Replacement Kit

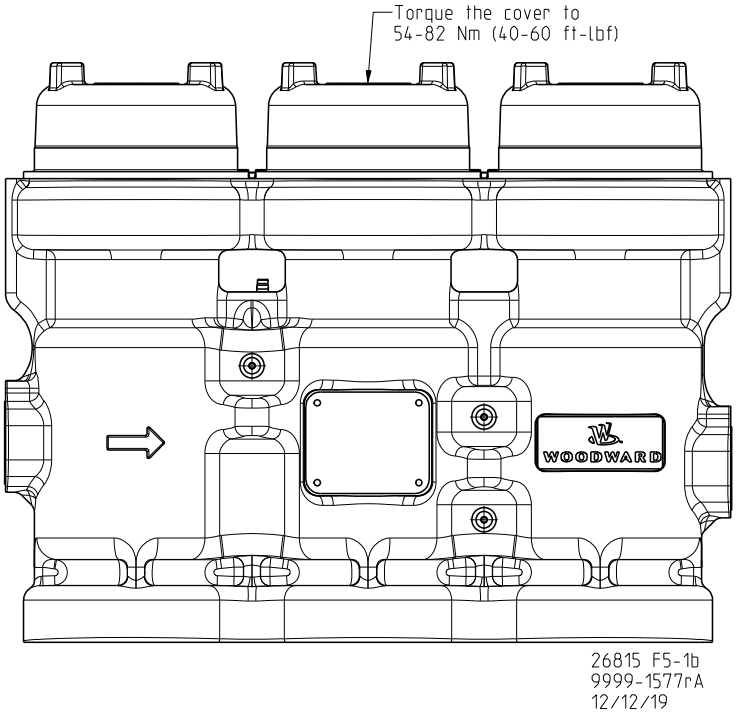

Figure 5-1b. Servo Cover Kit Proper Installation and Torque value

Return for Repair Instruction

Should the QuickTrip need to be returned for repair:

1. Attach a tag on the unit.
2. Include the following information on the tag:
   a. Customer's name and address
   b. The name and location where the equipment is installed
   c. Complete Woodward part number and serial number
   d. Description of the failure
   e. Instructions as to what type of repair is to be done

Protective Packing

The following procedures are used for protective packaging of the QuickTrip, when returning for repair:

1. Install shipping plates or plugs in all hydraulic connection ports or seal with tape.
2. Wrap the QuickTrip with packaging materials that will not damage the surface of the unit.
3. Place in a double-walled packing box.
4. Secure the unit inside of the box by removing all of its degrees of freedom using straps and belts, do not damage the unit.
5. Place at least 100 mm (4 inches) of tightly packed, industry-approved, shock-absorbing material around the unit.
6. Secure the box with strong metal straps around the outside of the box to increase the strength of the box.

Hardware Replacement

The user is permitted to replace some components of the QuickTrip in turbine shutdown conditions. The user is also permitted to replace some components of the QuickTrip during normal turbine operation conditions. The replacement components must be Woodward recommended products. Only this guarantees full component compatibility and functionality. All safety instructions and detailed procedures from this manual must be followed.

Service and Replacement Parts:

- **Service Manual (26842)** – Consult Woodward distributor for part number
- **Solenoid** – On-line replaceable. Consult local Woodward distributor or service manual for part number
- **Electronics module (PCBA)** – On-line replaceable. Consult local Woodward distributor or service manual for part number
- **Return Spring** – Consult local Woodward distributor or service manual for part number
- **Sight Window** – On-line replaceable. Consult local Woodward distributor or service manual for part number
- **Top Cover** – On-Line replaceable. Consult local Woodward distributor or service manual for part number
- **Bottom Cover** – Consult local Woodward distributor or service manual for part number
- **Interface Seals Kit(s)** – Consult local Woodward distributor or service manual for part number
- **Woodward Field Repair Tools Kit** – Consult Woodward distributor for part number.

Manually Stroking QuickTrip (powered)

Manually stroking valve procedure:

1. In order to manually stroke the QuickTrip valve, the actuators must be powered with 24 Vdc. Make sure the power supply is connected and operating while performing this procedure. This can be verified by viewing the LED status through the sight window on top of the valve. One or two blue LED's indicate that the power supply is connected and is turned on.

⚠WARNING

EXPLOSION HAZARD—Do not remove covers or connect/disconnect electrical connectors unless power has been switched off or the area is known to be non-hazardous.

2. If QuickTrip is in a run state, as indicated by a green LED as viewed through the sight glass, QuickTrip may be manually tripped either by de-energizing the logic solver interposing relay to initiate a trip state or by tripping the breaker to the Control In discrete input terminals on the QuickTrip electronics module (terminals 5 and 6 of TB2).
3. If QuickTrip is in a trip state, as indicated by a red as LED viewed through the sight glass, QuickTrip may be energized to close either by activating the logic solver interposing relay to initiate a run state or by supplying a separate 24 Vdc input to the Control In terminals on the QuickTrip electronics module (terminals 5 and 6 of TB2).

Manually Stroking QuickTrip using ProTechTPS (powered)

Manually stroking valve using ProTechTPS procedure:

1. If QuickTrip is in a run state, as indicated by a green LED as viewed through the sight glass, QuickTrip may be manually tripped by de-energizing the ProTechTPS interposing relay to initiate a trip. This may be done by using the Temporary Overspeed Setpoint Test (see ProTechTPS product manual for more detailed instructions on this function).

2. If QuickTrip is in a trip state, as indicated by a red LED as viewed through the sight glass, QuickTrip may be energized to close by activating the ProTechTPS interposing relay to initiate a run state. This may be done by pressing the RESET button on the front panel of the ProTechTPS (see the ProTechTPS product manual if module does not reset when the RESET button is pressed).

⚠WARNING

EXPLOSION HAZARD—Do not remove covers or connect/disconnect electrical connectors unless power has been switched off or the area is known to be non-hazardous.

Manually Stroking QuickTrip (un-powered)

Manually stroking valve procedure:

1. If the QuickTrip valve is unable to rotate using the powered methods above, the valve element may be manually rotated by use of a specially designed Woodward tool (tool # 1013-8807) which interfaces with the top of the spool shaft.
2. Make sure all power is disconnected from QuickTrip so the solenoid coil is de-energized.
3. Remove the cover clamp by removing the M5 screw (4mm hex key).
4. Remove electronics module cover using a spanner wrench (or WW tool # 1013-6603).

⚠WARNING

EXPLOSION HAZARD—Do not remove covers or connect/disconnect electrical connectors unless power has been switched off or the area is known to be non-hazardous.

⚠WARNING

Take care not to damage the electronics' cover seal, the cover surface, the threads, or the QuickTrip housing mating surface while removing the cover.

4. Remove top silkscreen wiring diagram cover by removing the four Philips screws.
5. Disconnect the solenoid wiring connector (TB3) using a 2.5mm flat-bladed screwdriver.
6. Remove position lever by loosening the M4 screw using a 3mm hex key.
7. Place tool # 1013-8807 onto shaft, aligning the set screw with the flat part of the shaft.
8. Tighten the set screw using (3/16") hex key.
9. Use a (1/2") socket and socket wrench to manually rotate the shaft clockwise and counter-clockwise. Note that there will be some resistance when rotating in the clockwise direction due to the failsafe return spring. Also note that the total rotation between end-stops is only about 51 degrees. The shaft will not rotate 360 degrees. If the shaft will not rotate with 50-100 lb-in of torque, do not force it to move. Return the unit to Woodward for evaluation and repair.
10. If the above operation to manually rotate the shaft was successful, reassemble the unit by following the below steps.
11. Remove tool # 1013-8807.
12. Re-install the position lever by placing it over the shaft, lining up the flat side of the lever with the flat on the shaft. Make sure the lever is pushed all the way down onto the shaft and that the magnet is facing up, away from the electronics module. Tighten the screw and torque to 1.4-1.7 N·m (12-15 in-lbf) using a 3 mm hex key.
13. Re-install the solenoid wiring connector (TB3). Snap the terminal block into the mating connector on the electronics module (TB3). Tighten the terminal block flange screws to 0.5 N·m (4.4 in-lbf) using a 2.5mm flat-bladed screwdriver.

IMPORTANT **Make sure that there is no contamination anywhere on the electronics module that could cause it to malfunction.**

14. Re-install the silkscreen wiring diagram cover by placing it onto the hex standoffs, lining up the four holes in the cover with the four standoffs. The rounded side of the cover should face towards the front of the QuickTrip unit (away from the conduit port).
15. Secure the cover with the four Philips screws and torque these to 0.3-.5 N·m (2.5-4.5 in-lbf) using a Philips screwdriver.
16. Re-install the electronics module cover by carefully threading it into the manifold. Thread it as far as possible by hand. Torque the cover to 136-190 N·m (100-140 ft-lbf) using a spanner wrench (or WW tool 1013-6603), tightening until the O-ring seal is compressed and the cover is fully seated against the housing.
17. Re-install the cover clamp and the M5 screws using a 4mm hex key.

⚠WARNING **Damage to sealing surfaces may result in moisture ingress, fire or explosion. Take care not to damage the electronics' cover seal, the cover surface, the threads, or the QuickTrip housing mating surface while installing the cover.**

Cleaning/Flushing the QuickTrip Hydraulic Cavities

Cleaning/Flushing QuickTrip Hydraulic Cavities procedure:

If QuickTrip is not operating normally or if a contaminant is known to have entered the QuickTrip hydraulic cavities, the QuickTrip cleaning/flushing procedure may be performed as follows.

1. Eliminate the source of the contamination either by polishing the hydraulic supply or by replacing the hydraulic supply with clean hydraulic oil.
2. Flow clean hydraulic oil through the QuickTrip at a maximum pressure of 500 psi, while manually stroking the valves using the Manual Stroking procedures above. Make sure to stroke all valves to an open position in order to ensure maximum oil flow through QuickTrip, then close the valves and repeat the process several times.
3. If the above procedure has been performed several times and QuickTrip still does not operate normally or the contaminant has not been flushed from the system, the valve may require repair. Consult the Troubleshooting and Service Options sections of this manual.

Troubleshooting

General

The following troubleshooting guide will help you isolate trouble with the QuickTrip valve electronics modules, solenoids, wiring, and system problems. Troubleshooting beyond this level is recommended ONLY when complete facility control testing is available.

Troubleshooting Procedure

This table is a general guide for isolating system problems. In general, most problems are a result of incorrect wiring or installation practices. Make sure that the system wiring, input/output connections, controls and contacts are correct and in good working order. Complete the checks in order. Each check assumes that the preceding checks have been completed and any problems have been corrected.

⚠WARNING **Be prepared to make an emergency shutdown of the turbine, or other type of prime mover, to protect against runaway or overspeed with possible personal injury, loss of life, or property damage.**

⚠WARNING

EXPLOSION HAZARD—Do not remove covers or connect/disconnect electrical connectors unless power has been switched off or the area is known to be non-hazardous.

⚠WARNING

ELECTRICAL SHOCK HAZARD—Follow all local plant and safety instructions/precautions before proceeding with Troubleshooting the QuickTrip.

⚠WARNING

The external ground lug shown on the installation drawing must be properly connected to ensure equipotential bonding. This will reduce the risk of electrostatic discharge in an explosive atmosphere.

Table 5-1. QuickTrip Troubleshooting Guide

General Faults

Problem	Cause	Remedy
One or More Valves Fails to Close (Reset)	Input Power below specified limit	Check power source and connections (Chapter 2: Electrical Specifications).
	Speed sensor logic solver is in a trip state	Ensure turbine is running and speed sensors and logic solver are functioning correctly and that all wiring connections are correct
	Malfunctioning electronics module or solenoid	Replace electronics module or solenoid (refer to manual 26842 for hardware replacement procedure).
	Valve seized / Excessive oil contamination	Ensure hydraulic fluid meets recommended filtration and ISO cleanliness levels specified in Chapter 2: Hydraulic Specifications. Ensure proof test is performed at an appropriate interval as recommended in Chapter 6: Safety Management. Replace and filter oil and flush clean oil through the valve.
	Operating temperature too high	Check ambient operating temperature and verify that it falls within the requirements outlined in the Chapter 2: Environmental Specifications.
One or More Valves Fails to Open (Trip)	Speed sensor logic solver is in a run state	Ensure all speed sensors and logic solver are functioning correctly and that all wiring connections are correct.
	Valve seized / Excessive oil contamination	Ensure hydraulic fluid meets recommended filtration and ISO cleanliness levels specified in Chapter 2: Hydraulic Specifications. Ensure proof test is performed at an appropriate interval as recommended in Chapter 6: Safety Management. Replace and filter oil and flush clean oil through the valve.
	Supply hydraulic pressure exceeds maximum	Check hydraulic supply pressure and regulator setting
	Broken return spring	Check/replace return spring (refer to manual 26842 for hardware replacement procedure)
Trip time too long (> 50 ms)	Supply hydraulic pressure exceeds maximum	Check hydraulic supply pressure and regulator setting
	Valve seized / Excessive oil contamination	Ensure hydraulic fluid meets recommended filtration and ISO cleanliness levels specified in Chapter 2: Hydraulic Specifications. Ensure proof test is performed at an appropriate interval as recommended in Chapter 6: Safety Management. Replace and filter oil and flush clean oil through the valve
Power Supply #1 or #2 LED indicator is not on	Power supply is not turned on or wiring is not connected	Check power source and connections (Chapter 2: Electrical Specifications).
	Power supply voltage or current are below recommended ratings	
	LED damaged or malfunctioning	Replace electronics module (refer to manual 26842 for hardware replacement procedure)

Table 5-1. QuickTrip Troubleshooting Guide (continued)

Run LED indicator is not on	Power supply is not turned on or wiring is not connected	Check power source and connections (Chapter 2: Electrical Specifications).
	Power supply voltage or current are below recommended ratings	
	Valve is in a tripped state	Verify that speed sensors and logic solver are functioning correctly and that all wiring connections are correct
	Position lever/magnet not correctly positioned over sensor	Verify that the position lever is installed at the top of the shaft and is seated all the way down onto the shaft indexing surface. Also ensure the position lever is correctly positioned over the sensors on the electronics module.
	LED damaged or malfunctioning	Replace electronics module (refer to manual 26842 for hardware replacement procedure)
Trip LED indicator is not on	Power supply is not turned on or wiring is not connected	Check power source and connections (Chapter 2: Electrical Specifications).
	Valve is in a run state	Ensure all speed sensors and logic solver are functioning correctly and that all wiring connections are correct.
	Position lever/magnet not correctly positioned over sensor	Verify that the position lever is installed at the top of the shaft and is seated all the way down onto the shaft indexing surface. Also ensure the position lever is correctly positioned over the sensors on the electronics module.
	LED damaged or malfunctioning	Replace electronics module (refer to manual 26842 for hardware replacement procedure)
Trip Header Pressure Fails to Decrease Below Trip Pressure When Valves are Open	Trip header orifice size is too large	Check orifice size and replace with a smaller orifice
	Hydraulic ports blocked	Disconnect and check hydraulic ports for obstructions
Trip Header Pressure is Too Low When Valves are Closed	Trip header orifice size is too small	Check orifice size and replace with a larger orifice

Table 5-1. QuickTrip Troubleshooting Guide (continued)

Trip #1 or Trip #2 Discrete Outputs Not Functioning	Wiring not connected properly	Check all wiring between trip terminals on electronics module and logic solver
	Valve is in a run state	Verify that all speed sensors and logic solver are functioning correctly and that all wiring connections are correct
	Power supply is not turned on or wiring is not connected	Check power source and connections (Chapter 2: Electrical Specifications).
	Power supply voltage or current are below recommended ratings	
	Malfunctioning electronics module	Replace electronics module (refer to manual 26842 for hardware replacement procedure)
Run #1 or Run #2 Discrete Outputs Not Functioning	Wiring not connected properly	Check all wiring between trip terminals on electronics module and logic solver
	Valve is in a tripped state	Verify that the turbine is in operation and that the speed sensors and logic solver are functioning correctly and that all wiring connections are correct
	Power supply is not turned on or wiring is not connected	Check power source and connections
	Power supply voltage or current are below recommended ratings	Check power source and ensure ratings meet the requirements in the Electrical Specifications section of this manual
	Malfunctioning electronics module or solenoid	Replace electronics module and/or solenoid. (refer to manual 26842 for hardware replacement procedure)

Chapter 6.
Safety Management

Product Variations Certified

The functional safety requirement in this manual applies to all QuickTrip variations.

These products are certified for use in applications up to SIL3 according to IEC61508.

Figure 6-1. TUV Rheinland SIIL Certification Stamp

Safe State

The QuickTrip is designed so that the safe state is configured for de-energize to trip. De-energize to trip will place the valves into their open state.

The de-energize-to-trip functionality is implemented such that a complete loss of power to the module results in a trip of that module. When power is again supplied to the electrical modules, they will power up in the tripped state when a trip condition is present or in the run state when a run condition is present.

Table 6-1. De-Energize-to-Trip Functionality

Configuration	Module Power Loss State	Module Power Up State
De-energize to trip, trip condition present	Tripped	Tripped
De-energize to trip, run condition present	Tripped	Not Tripped

SIL Specifications

PFD and PFH calculations have been performed on the QuickTrip according IEC61508. For SIL3, IEC states the following requirements.

Table 6-2. Calculation Types and SIL 3 Values

Type	SIL 3 Value
PFH	≥ 10^{-8} to < 10^{-7}
PFD	≥ 10^{-4} to < 10^{-3}
SFF	≥ 60% to < 90%

Table 6-3. QuickTrip SIL3 Certification values

PFD	
PFD	**Proof Test Interval***
2.97E-7	1 - 3 days
4.77E-6	6 months
9.44E-6	1 year

Note: In order to maintain the dirt tolerance and to verify correct function of the QuickTrip, it is recommended that the proof test interval be set to between 1 and 7 days. If using the ProTechTPS, refer to Auto-Sequence Test in Chapter 4. If using a different logic solver, refer to that manufacturer's product manual for instructions on conducting and automating the proof test.

Table 6-4. Safe Failure Fraction (SFF) Value

Safe Failure Fraction
SFF > 93%

Table 6-5. Diagnostic Coverage (DC) Value

Diagnostic Coverage
DC > 83%

Failure Rate Data

The Mean Time Between Failure (MTBF) is a measure of time between failures that cause a complete process shutdown. In determining this number, IEC61508 evaluation takes into account safe failure and dangerous detected failures that cause a module trip.

Table 6-6. MTBF Value

MTBF
4.95E6 hrs

Because of the nature of the 2-o-o-3 voting structure, a single module trip does not shut down the process.

Response time data

The response time for a safety system must be less than the process safety time.
The system integrator must determine the process safety time and the response time of all elements (sensors, logic solver, QuickTrip, actuators, etc.) that make up the total process safety time. For this purpose, the QuickTrip response time is given below.

Table 6-7. QuickTrip Response Time Value

Response Time	
QuickTrip Response Time	< 50 ms

The response time of the QuickTrip is the time from when the control signal is removed from the QuickTrip terminal block to the point where the valves have rotated to their full open position (ref Figure 6-1 below).

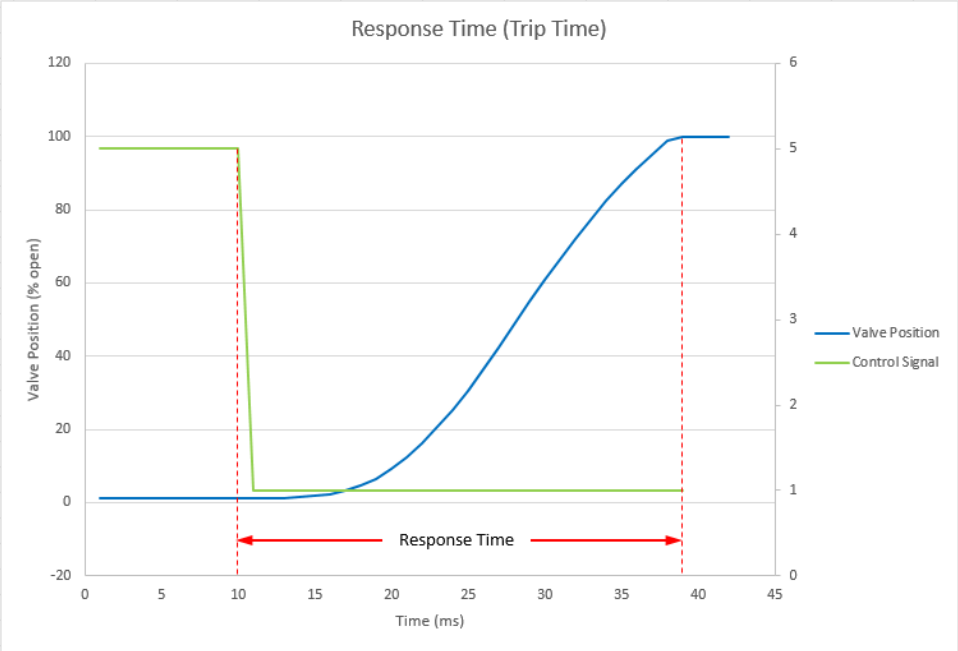

Figure 6-2. Response Time

Limitations

When proper installation, maintenance, proof testing, and environmental limitations are observed, the product life of the QuickTrip is 20 years.

Table 6-8. Environmental Specifications:

Operating Temperature	–40 to +85 °C
Storage Temperature (Non-operational)	–40 to +85 °C
Relative humidity	up to 95% non-condensing
Vibration	2 h/axis, 1.04 Grms, 10–500 Hz, three axis
Shock	±3 pulses, 10 G, 11 ms sawtooth shock pulse, three axis
IP rating	66
Altitude	up to 3000 meters above sea level
Electromagnetic Compatibility	Emissions: EN61000-6-4 Immunity: EN61000-6-2

IMPORTANT **These limitations are critical to the SIL certification. See Ch. 2 for a complete list of specifications.**

Management of Functional Safety

The QuickTrip is intended for use according the requirements of a safety lifecycle management process such as IEC61508 or IEC61511. The safety performance numbers in this chapter can be used for the evaluation of the overall safety lifecycle.

Restrictions

The user must complete a full functional check of the QuickTrip after initial installation, and after any modification of the programming of the logic solver or configuration of the device. This functional check should include as much of the safety system as possible, such as sensors, transmitters, actuators and trip blocks. When used with the Woodward ProTechTPS, the ProTechTPS has the capability to facilitate the automatic checkout and periodic maintenance of the safety system. For help on programming, see the chapters on functionality, configuration and the example applications in the ProTechTPS manual.

The QuickTrip must be used within the published specification in this manual.

Competence of Personnel

All persons involved in the installation and maintenance of the QuickTrip unit must have appropriate training. In the event that QuickTrip is used with the Woodward ProTechTPS logic solver, all persons involved in the initial design or modification of the programmable software, installation and maintenance must have appropriate training. Training and guidance materials include this manual, the ProTechTPS service tool, and any training programs available at Woodward. See Chapter 7 (Product Support and Service Options) for more information.

Operation and Maintenance Practice

A periodic proof (functional) test of the QuickTrip is required to verify that no dangerous faults not detected by external means remain undetected. More information is in the “Proof Testing” section of this chapter. The frequency of the proof test is determined by the overall safety system design, of which the QuickTrip is a part. The safety numbers are given in the following sections to help the system integrator determine the appropriate test interval.

Installation and Site Acceptance Testing

Installation and use of the QuickTrip must conform to the guidelines and restrictions included in this manual. No other information is needed for installation and maintenance.

Functional Testing after Initial Installation

A functional test of the QuickTrip is required prior to use as a safety system. This should be done as part of the overall safety system installation check and should include all I/O interfaces to and from the QuickTrip that are part of the safety system. For guidance on the functional test, see the proof test procedure below.

Functional Testing after Changes

A functional test of the QuickTrip is required after making any changes that affect the safety system.

Proof Testing (Full Functional Test)

The QuickTrip must be periodically proof tested to ensure there are no dangerous faults present that are not detected by external diagnostics. The test procedure will set the trip outputs on the module under test into a trip state (de-energized for a de-energize-to-trip configuration). It is possible to automate several steps of the proof test procedure shown below using the programmability and test mode configurability of the ProTechTPS, but the intent of the steps below must be met. If using a different logic solver, consult the manual for the unit to determine the steps required to implement a proof test for QuickTrip.

A full proof test is assumed to be done once per year.

With the procedure below, the user can expect 99% test coverage of the dangerous failures that are not tested by external diagnostics.

Functional Verification (Proof) Test Procedure (module level):

1. The following procedure should be followed for each QuickTrip module (A, B and C)
2. Ensure power is connected to one or both power inputs on QuickTrip module (terminals 1 & 2 and 3 & 4)
3. Verify that one or both blue LED's on the QuickTrip electronics module are lit indicating that either a single power supply or two redundant power supplies are connected and turned on.
4. Measure voltage at the QuickTrip terminals and verify that it is within the range 24 Vdc ± 10%.
5. Verify that the red LED on the QuickTrip electronics module is lit indicating the valve is in the tripped (open) position
6. Verify trip feedback outputs are active on the QuickTrip electronics module. This can be done by using an ohmmeter to verify continuity between terminals 7 & 8 and terminals 9 & 10 on the QuickTrip electronics module. Note that there should be no continuity on the run feedback terminals 11 & 12 and 13 & 14. The ProTechTPS or other logic solver can also be used to detect trip feedback.
7. Use ProTechTPS or other logic solver to start the module and energize QuickTrip by applying 24 Vdc to the control terminals (5 & 6)
8. Verify that the green LED on the QuickTrip electronics module is lit indicating the valve is in the energized (closed) position
9. Verify run feedback outputs are active on the QuickTrip electronics module. This can be done by using an ohmmeter to verify continuity between terminals 11 & 12 and terminals 13 & 14 on the QuickTrip electronics module.
   Note: there should be no continuity on the trip feedback terminals 7 & 8 and 9 & 10. The ProTechTPS or other logic solver can also be used to detect run feedback if configured to do so (refer to ProTechTPS product manuals, Woodward numbers 26501V1 and 26501V2).
10. Use ProTech or other logic solver to trip the module and verify the red LED is lit indicating the valve is once again in the tripped (open) position
11. Using the ProTechTPS or other logic solver, check Trip Log or Trip Cycle Time Log and verify the most recent trip time is less than 50 ms.
12. Use ProTechTPS or other logic solver to start all modules and energize all QuickTrip modules by applying 24 Vdc to the control terminals (5 & 6) for each module.
13. Apply hydraulic pressure to the QuickTrip inlet and verify the normal operating trip header pressure is reached.
14. Confirm the ability of the QuickTrip to hold trip header pressure when any one QuickTrip module is tripped (module A, Module B, or Module C). Confirm this for all modules individually. Note: When any QuickTrip module is tripped, there will be a slight decrease in trip header pressure since steady-state hydraulic leakage through the unit increases. This slight decrease in trip header pressure should remain above the normal trip pressure for the turbine trip system.
15. Confirm the ability of the QuickTrip to dump trip header pressure when any two QuickTrip modules are tripped (2oo3 voting operation). Trip QuickTrip modules A and B and confirm the trip header pressure quickly drops below the normal trip pressure for the turbine trip system.
16. Repeat the above test for the following combinations of two and three modules:
17. Modules B and C
18. Modules A and C
19. Modules A, B and C
20. If there are any failures of the QuickTrip valve to operate correctly, consult the Repair and Troubleshooting section of this manual (Chapter 5).

Diagnostic Testing (On-Line Test)

Because of the 2-o-o-3 configuration of the QuickTrip, it is possible to perform a diagnostic test while the QuickTrip is on-line and the turbine is running. The test procedure will set the trip outputs on the module under test into a trip state (de-energized for a de-energize-to-trip configuration) and for only one module at a time. It is possible to automate the procedure shown below by using a built-in function in the ProTech TPS called “Auto-Sequence Test” or with the programmability and test mode configurability of the ProTechTPS, but the intent of the steps below must be met. If using a different logic solver, consult the manual for the unit to determine the steps required to implement a diagnostic test for QuickTrip.

With the procedure below, the user can expect 83% test coverage of the dangerous failures that are not tested by external diagnostics.

Diagnostic Test Procedure:

1. Verify that each QuickTrip module is in a run state (valve closed). This can be done by verifying that a green light is lit on each QuickTrip electronics module, or by verifying there are no trip alarms on the ProTech TPS (or other logic solver).
2. If using a ProTech TPS logic solver, initiate the Auto-Sequence Test by accessing the “Test Menu”, then “Auto-Sequence Test” on the front panel (refer to Chapter 4 “Operation” for additional information).
3. The Auto-Sequence test will automatically ramp up the internal frequency generator for module A until it exceeds the overspeed set point at which time the control signal is interrupted and the QuickTrip module trips. A trip alarm is momentarily displayed. Then, this module resets and the test is repeated, sequentially, on modules B and C.
4. Once the Auto-Sequence test has completed, both ProTech TPS and QuickTrip will return to a normally operating state.
5. Upon completion of the Auto-Sequence Test, check for any trip alarms that are not cleared and, if ProTech is configured to do so, verify there are no run alarms (failure to energize to a run state).
6. Verify the trip time for each module by checking the Trip Cycle Time Log. This trip time can be checked through the ProTech TPS front panel display by pressing “View Logs”, then “Trip Cycle Time Log”. This log displays the last 20 trip events and the time from when the control signal was dropped to the time the QuickTrip valve rotated to the open position and the trip position sensor annunciated a trip signal back to ProTech. This trip time should be less than 50ms.
7. If there are any failures of a QuickTrip module (valve) to rotate to an open or closed state when commanded to do so or if the trip time is greater than 50ms, consult the Repair and Troubleshooting section in this manual (Chapter 5) for assistance.

Chapter 7.
Product Support and Service Options

Product Support Options

If you are experiencing problems with the installation, or unsatisfactory performance of a Woodward product, the following options are available:

- Consult the troubleshooting guide in the manual.
- Contact the manufacturer or packager of your system.
- Contact the Woodward Full Service Distributor serving your area.
- Contact Woodward technical assistance (see “How to Contact Woodward” later in this chapter) and discuss your problem. In many cases, your problem can be resolved over the phone. If not, you can select which course of action to pursue based on the available services listed in this chapter.

OEM or Packager Support: Many Woodward controls and control devices are installed into the equipment system and programmed by an Original Equipment Manufacturer (OEM) or Equipment Packager at their factory. In some cases, the programming is password-protected by the OEM or packager, and they are the best source for product service and support. Warranty service for Woodward products shipped with an equipment system should also be handled through the OEM or Packager. Please review your equipment system documentation for details.

Woodward Business Partner Support: Woodward works with and supports a global network of independent business partners whose mission is to serve the users of Woodward controls, as described here:

- A **Full Service Distributor** has the primary responsibility for sales, service, system integration solutions, technical desk support, and aftermarket marketing of standard Woodward products within a specific geographic area and market segment.
- An **Authorized Independent Service Facility (AISF)** provides authorized service that includes repairs, repair parts, and warranty service on Woodward's behalf. Service (not new unit sales) is an AISF's primary mission.
- A **Recognized Turbine Retrofitter (RTR)** is an independent company that does both steam and gas turbine control retrofits and upgrades globally, and can provide the full line of Woodward systems and components for the retrofits and overhauls, long term service contracts, emergency repairs, etc.

A current list of Woodward Business Partners is available at **www.woodward.com/directory**.

Product Service Options

The following factory options for servicing Woodward products are available through your local Full-Service Distributor or the OEM or Packager of the equipment system, based on the standard Woodward Product and Service Warranty (5-01-1205) that is in effect at the time the product is originally shipped from Woodward or a service is performed:

- Replacement/Exchange (24-hour service)
- Flat Rate Repair
- Flat Rate Remanufacture

Replacement/Exchange: Replacement/Exchange is a premium program designed for the user who is in need of immediate service. It allows you to request and receive a like-new replacement unit in minimum time (usually within 24 hours of the request), providing a suitable unit is available at the time of the request, thereby minimizing costly downtime. This is a flat-rate program and includes the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205).

This option allows you to call your Full-Service Distributor in the event of an unexpected outage, or in advance of a scheduled outage, to request a replacement control unit. If the unit is available at the time of the call, it can usually be shipped out within 24 hours. You replace your field control unit with the like-new replacement and return the field unit to the Full-Service Distributor.

Charges for the Replacement/Exchange service are based on a flat rate plus shipping expenses. You are invoiced the flat rate replacement/exchange charge plus a core charge at the time the replacement unit is shipped. If the core (field unit) is returned within 60 days, a credit for the core charge will be issued.

Flat Rate Repair: Flat Rate Repair is available for the majority of standard products in the field. This program offers you repair service for your products with the advantage of knowing in advance what the cost will be. All repair work carries the standard Woodward service warranty (Woodward Product and Service Warranty 5-01-1205) on replaced parts and labor.

Flat Rate Remanufacture: Flat Rate Remanufacture is very similar to the Flat Rate Repair option with the exception that the unit will be returned to you in “like-new” condition and carry with it the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205). This option is applicable to mechanical products only.

Returning Equipment for Repair

If a control (or any part of an electronic control) is to be returned for repair, please contact your Full-Service Distributor in advance to obtain Return Authorization and shipping instructions.

When shipping the item(s), attach a tag with the following information:

- Return authorization number
- Name and location where the control is installed
- Name and phone number of contact person
- Complete Woodward part number(s) and serial number(s)
- Description of the problem
- Instructions describing the desired type of repair

Packing a Control

Use the following materials when returning a complete control:

- Protective caps on any connectors
- Antistatic protective bags on all electronic modules
- Packing materials that will not damage the surface of the unit
- At least 100 mm (4 inches) of tightly packed, industry-approved packing material
- A packing carton with double walls
- A strong tape around the outside of the carton for increased strength

NOTICE

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Replacement Parts

When ordering replacement parts for controls, include the following information:

- The part number(s) (XXXX-XXXX) that is on the enclosure nameplate
- The unit serial number, which is also on the nameplate

Engineering Services

Woodward offers various Engineering Services for our products. For these services, you can contact us by telephone, by email, or through the Woodward website.

- Technical Support
- Product Training
- Field Service

Technical Support is available from your equipment system supplier, your local Full-Service Distributor, or from many of Woodward's worldwide locations, depending upon the product and application. This service can assist you with technical questions or problem solving during the normal business hours of the Woodward location you contact. Emergency assistance is also available during non-business hours by phoning Woodward and stating the urgency of your problem.

Product Training is available as standard classes at many of our worldwide locations. We also offer customized classes, which can be tailored to your needs and can be held at one of our locations or at your site. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability.

Field Service engineering on-site support is available, depending on the product and location, from many of our worldwide locations or from one of our Full-Service Distributors. The field engineers are experienced both on Woodward products as well as on much of the non-Woodward equipment with which our products interface.

For information on these services, please contact us via telephone, email us, or use our website: **www.woodward.com**.

Contacting Woodward's Support Organization

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory at **www.woodward.com/directory**, which also contains the most current product support and contact information.

You can also contact the Woodward Customer Service Department at one of the following Woodward facilities to obtain the address and phone number of the nearest facility at which you can obtain information and service.

Products Used in Electrical Power Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany:	
Kempen	+49 (0) 21 52 14 51
Stuttgart	+49 (711) 78954-510
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Products Used in Engine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (711) 78954-510
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
United States	+1 (970) 482-5811

Products Used in Industrial Turbomachinery Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Technical Assistance

If you need to contact technical assistance, you will need to provide the following information. Please write it down here before contacting the Engine OEM, the Packager, a Woodward Business Partner, or the Woodward factory:

General

Your Name _____

Site Location _____

Phone Number _____

Fax Number

Prime Mover Information

Manufacturer _____

Turbine Model Number _____

Type of Fuel (gas, steam, etc.) _____

Power Output Rating _____

Application (power generation, marine, etc.) _____

Control/Governor Information

Control/Governor #1

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Control/Governor #2

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Control/Governor #3

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Symptoms

Description _____

_____

If you have an electronic or programmable control, please have the adjustment setting positions or the menu settings written down and with you at the time of the call.

Chapter 8.
Asset Management and Refurbishment Scheduling Period

The following recommendations regarding the Woodward designed and manufactured QuickTrip trip block assembly are to assist in properly managing the reliability, availability and “safety of operation” expectations established for turbines. While there are electronic control systems designed to monitor and diagnose the operational performance of these components, control monitoring cannot replace normal preventative maintenance practices. It is important to follow these recommendations in order to avoid unnecessary and unscheduled shutdowns.

This product is designed for continuous operation under normal industrial operating conditions. There are no components that require periodic service between scheduled major turnarounds (normally every five to eight years depending on the site and application). During major outages, Woodward recommends the QuickTrip be send back to Woodward or a Woodward Authorized Independent Service Facility (AISF) for inspection, component servicing and to take advantage of any related hardware improvements.

Installations that do not meet “normal” industrial operating conditions may require customized maintenance cycles to maximize reliability, performance, and asset life. Contact your local Woodward Representative for a detailed evaluation of your site conditions to determine the right maintenance cycles for your installation.

Woodward’s overhaul services will return the unit to “like new” condition, ready for another full operating cycle, lasting until the next planned maintenance outage. Upon reaching the recommended maintenance cycle of the auxiliary equipment, please contact either the site turbine OEM service representative, local Woodward distributor or Woodward Authorized Independent Service Facility to initiate services. Refer to Chapter 7 for Product Support and Services options.

Chapter 9.
Long-Term Storage Requirements

Units that will not be put into service within twelve months should be packaged for long-term storage as described in Woodward manual 25075, *Commercial Preservation Packaging for Storage of Mechanical-Hydraulic Controls*. This product is designed for continuous storage in IP66 rated locations with an ambient temperature of –40 °C to +85 °C.

Appendix
Commissioning Checklist

When installing and commissioning the QuickTrip unit, the following checklist can be used as a guide to ensure proper installation and successful commissioning.

Table A-1. Installation and Commissioning Checklist

Category	Parameter	Specification	This Installation
Hydraulics	Trip Header and Drain Port connections	1.250 SAE J518 Code 61 Flange	
	Metric Port connection Hardware	M10 x 1.5 bolts	
	Torque Value	34 to 48 N·m (25 to 35 ft-lbf)	
	Trip Header Pressure	34.5 bar 500 psi max	
	Drain Pressure	3.4 50 psi max	
	External Hydraulic Leaks	None	
Power Supply	Supply Voltage (measured at QuickTrip terminals)	24 Vdc ± 10%	
	Supply Current (measured at QuickTrip terminals)	2.6 Amps Max (per module)	
	Wiring: PS #1 –	TB1, Terminal 1	
	Wiring: PS #1 +	TB1, terminal 2	
	Wiring: PS #2 -	TB1, Terminal 3	
	Wiring: PS #2 +	TB1, Terminal 4	
	Terminal Torque	0.2-0.25 N·m (1.75-2.25 in-lbf)	
	Breakers	Breakers used between PS + output and QuickTrip	
Control Input	Wiring: Control +	TB2, terminal 5	
	Wiring: Control -	TB2, Terminal 6	
	Terminal Torque	0.2-0.25 N·m (1.75-2.25 in-lbf)	
	Voltage	15-32 Vdc	
	Current	20 mA Min	
	Breakers	Breakers used between Control + output and QuickTrip	

Table A-1. Installation and Commissioning Checklist (Continued)

Category	Parameter	Specification	This Installation
Discrete Outputs	Wiring: Trip #1 NO	TB2, Terminal 7	
	Wiring: Trip #1 COM	TB2, Terminal 8	
	Wiring: Trip #2 NO	TB2, Terminal 9	
	Wiring: Trip #2 COM	TB2, Terminal 10	
	Terminal Torque	0.2-0.25 N·m (1.75-2.25 in-lbf)	
	Breakers	Breakers used between logic solver NO and QuickTrip	
	Wiring: Run #1 NO	TB2, Terminal 11	
	Wiring: Run #1 COM	TB2, Terminal 12	
	Wiring: Run #2 NO	TB2, Terminal 13	
	Wiring : Run #2 COM	TB2, Terminal 14	
	Terminal Torque	0.2-0.25 N·m (1.75-2.25 in-lbf)	
	Breakers	Breakers used between logic solver NO and QuickTrip	
	Connector Flange Screw Torque	0.5 N·m (4.4 in-lbf)	
Electronics Module	Power Supply #1 LED Indicator	ON	
	Power Supply #2 LED Indicator	ON (only if PS#2 is used)	
	Run LED Indicator (green)	ON when valve in run (closed) state	
	Trip LED Indicator (red)	ON when valve in trip (open) state	
Top cover	Torque	136-190 N·m (100-140 ft-lbf)	
Top Cover Retaining Clip Screws	Torque	2-2.7 N·m (18-25 in-lbf)	
Actuation Times	Trip Time	< 50 ms	
	Actuation (close) Time	< 1 s	
Proof Test	Operation of Proof Test	Initiate proof test and ensure correct operation of all three QuickTrip modules	

Revision History

Changes in Revision J—
- Updated the SIL certificate
- Changed the recommended test interval from 1-7 days to 1-3 days on Pg. 36
- Changed the Diagnostic Coverage from DC>86% to DC>83% on Pg. 50
- Proof testing, added line " A full proof test is assumed to be done once per year." on Pg. 52
- Replaced the EU DoC

Changes in Revision H—
- Updated both ATEX directives in the Regulatory Compliance section
- Replaced part number 8923-2144 with 8923-2690 in Table 1-3
- Added five Chemically Resistant part numbers to Table 1-1
- Added Ingress Protection to Environmental Specifications table in Chapter 2
- Replaced the EU DoC

Changes in Revision G—
- Added QuickTrip Cover Replacement Kit section
- Added Figures 5-1a and 5-1b

Changes in Revision F—
- Deleted contaminant references in Dirt Tolerance section
- Added Chemically Resistant Versions section to Chapter 1

Changes in Revision E—
- Changed Item number references in Table 1-1 and Figure 1-3
- Changed ground lug torque value in the Unit Grounding section in Chapter 3

Changes in Revision D—
- Updated ATEX Directive and added instructions to Regulatory Compliance section
- Added Ex nA nC Minimum Ambient Temperature to Environmental Specifications in Chapter 2
- Added IMPORTANT box to Limitations section in Chapter 6
- Updated EU DoC

Changes in Revision C—
- Replaced Figure 3-2 with a corrected chart

Changes in Revision B—
- Updated specifications in Chapter 1 first paragraph, in Hydraulic Connections section in Chapter 3, and in the Commissioning Checklist in the Appendix
- Deleted Minimum Supply Pressure from Hydraulic Specifications
- Changed Maximum Trip Header Pressure in Hydraulic Specifications
- Changed content to clarify Oil Flow/Cv Rating in Hydraulic Specifications
- Added Table 2-1
- Removed Figures 2-2 and 2-3
- Added Flow Coefficient and Flow Rate Calculation formulas and variable definitions
- Updated former Figure 2-4 and 2-5 which were redesignated Figures 2-2 and 2-3

Revision A—
- Added new part number
- Reordered and updated Compliance section
- New DOC/DOI

Declarations

Certificate

SIL/PL Capability

TÜVRheinland CERTIFIED

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ID 0000000000

No.: 968/V 1185.00/20

Product tested	Electro-Hydraulic Trip Block Assembly	**Certificate holder**	Woodward Inc. 1041 Woodward Way Fort Collins, CO 80524 USA
Type designation	QuickTrip Drawing No. 9934-5620 Rev. B		
Codes and standards	IEC 61508 Parts 1-2 and 4-7:2010		
Intended application	Safety Function: Drain supply pressure The Trip Block Assembly is constructed in a 2oo3 configuration and has an internal hardware fault tolerance HFT = 1. It is suitable for use in a safety instrumented system up to SIL 3 in low demand mode applications.		
Specific requirements	The instructions of the associated Installation, Operating and Safety Manual shall be considered.		

Summary of test results see back side of this certificate.

Valid until 2025-09-23

The issue of this certificate is based upon an evaluation in accordance with the Certification Program CERT FSP1 V1.0:2017 in its actual version, whose results are documented in Report No. 968/V 1185.00/20 dated 2020-09-23. This certificate is valid only for products, which are identical with the product tested.

TÜV Rheinland Industrie Service GmbH
Bereich Automation
Funktionale Sicherheit
Am Grauen Stein, 51105 Köln

Köln, 2020-09-23

Certification Body Safety & Security for Automation & Grid

Dipl.-Ing. Gebhard Bouwer

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968/V 1185.00/20 - page 2

TÜVRheinland®
Precisely Right.

Holder: Woodward, Inc.
3800 North Wilson Ave – Dock C
P.O. Box 3800
Loveland, CO, 80538, USA

Product tested: Electro-Hydraulic Trip Block Assembly
QuickTrip
Drawing 9934-5620 Rev. B

Results of Assessment

Route of Assessment		$2_H / 1_S$	
Type of Sub-system		Type A	
Mode of Operation		Low Demand Mode	
Hardware Fault Tolerance	HFT	1 (2oo3)	
Systematic Capability		SC 3	
Dangerous Failure Rate 1oo1	λ_{D_1oo1}	2.62 E-07 / h	262 FIT
Dangerous Undetected Failure Rate 1oo1	λ_{DU_1oo1}	4.55 E-08 / h	45 FIT
Dangerous Detected Failure Rate 1oo1	λ_{DD_1oo1}	2.17 E-07 / h	217 FIT

Assumptions for the calculations above: DC = 83 %, following the manufatcurer recommendations in the Safety Manual for an automated on-line test.

Average Probability of Failure on Demand 2oo3	$PFD_{avg}(T_1)$	1.94 E-04

Assumptions for the calculations above:
DC = 83 % (Diagnostic Test interval = 8760 h), PTC = 99 % (T_1), T_1 = 1 year, MRT = 8 h, β_{2oo3} = 15 %

Average Probability of Failure on Demand 2oo3	$PFD_{avg}(T_1)$	3.08 E-05

Assumptions for the calculations above:
DC = 83 % (Diagnostic Test interval = 72 h), PTC = 99 % (T_1), T_1 = 1 year, MRT = 8 h, β_{2oo3} = 15 %

Average Probability of Failure on Demand 2oo3	$PFD_{avg}(T_1)$	3.04 E-05

Assumptions for the calculations above:
DC = 83 % (Diagnostic Test interval = 48 h), PTC = 99 % (T_1), T_1 = 1 year, MRT = 8 h, β_{2oo3} = 15 %

Average Probability of Failure on Demand 2oo3	$PFD_{avg}(T_1)$	3.00 E-05

Assumptions for the calculations above:
DC = 83 % (Diagnostic Test interval = 24 h), PTC = 99 % (T_1), T_1 = 1 year, MRT = 8 h, β_{2oo3} = 15 %

Origin of failure rates

The stated failure rates for low demand are the result of an FMEDA with specified failure rates for the design and manufacturing process.

Furthermore the results have been verified by qualification tests and field-feedback data of the last 5 years. Failure rates include failures that occur at a random point in time and are due to degradation mechanisms such as ageing. The stated failure rates do not release the end-user from collecting and evaluating application-specific reliability data.

Periodic Tests and Maintenance

The given values require periodic tests and maintenance as described in the Safety Manual.
The operator is responsible for the consideration of specific external conditions (e.g. ensuring of required quality of media, max. temperature, time of impact), and adequate test cycles.

TÜV Rheinland Industrie Service GmbH, Am Grauen Stein, 51105 Köln / Germany

EU DECLARATION OF CONFORMITY

EU DoC No.:	00467-04-EU-02-01
Manufacturer's Name:	WOODWARD, INC.
Manufacturer's Contact Address:	1041 Woodward Way Fort Collins, CO 80524 USA
Model Name(s)/Number(s):	QuickTrip Electro-Hydraulic Trip Block Assembly
The object of the declaration described above is in conformity with the following relevant Union harmonization legislation:	Directive 2014/34/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility (EMC)
Markings in addition to CE marking:	Ex II 2 G, Ex db IIB T4 Gb Ex II 3 G, Ex nA nC IIC T4 Gc
Applicable Standards:	EN 61000-6-2:2005 - EMC Part 6-2: Generic Standards – Immunity for Industrial Environments EN 61000-6-4:2007/A1:2011 - EMC Part 6-4: Generic Standards – Emissions for Industrial Environments EN 60079-0 :2018 - Explosive Atmospheres – Part 0 : Equipment – General requirements (A review against EN IEC 60079-0:2018, which is harmonized, shows no significant changes relevant to this equipment so EN 60079-0:2012/A11 :2013 continues to represent "State of the Art") EN 60079-1:2014 – Explosive Atmospheres – Part 1 : Equipment protection by type of protection "d" EN 60079-15:2010 - Explosive Atmospheres - Part 15: Equipment protection by type of protection "n"
Third Party Certification:	Zone 1: SIRA15ATEX1230X Zone 2: SIRA15ATEX4231X CSA Group Netherlands B.V. (NB2562) Utrechseweg 310, 6812 AR, Arnhem, Netherlands
Conformity Assessment:	ATEX Annex IV - Production Quality Assessment, 01 220 113542 TUV Rheinland Industrie Service GmbH (0035) Am Grauen Stein, D51105 Koln

This declaration of conformity is issued under the sole responsibility of the manufacturer
We, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s).

MANUFACTURER

Signature

Mike Row

Full Name

Engineering Manager

Position

Woodward, Fort Collins, CO, USA

Place

24-March-2020

Date

5-09-1183 Rev 28

DECLARATION OF INCORPORATION
Of Partly Completed Machinery
2006/42/EC

File name: 00467-04-EU-02-02
Manufacturer's Name: WOODWARD INC.
Manufacturer's Address: 1041 Woodward Way
Fort Collins, CO 80524 USA
Model Names: QuickTrip
This product complies, where applicable, with the following Essential Requirements of Annex I: 1.1, 1.2, 1.3, 1.5, 1.6, 1.7

The relevant technical documentation is compiled in accordance with part B of Annex VII. Woodward shall transmit relevant information if required by a reasoned request by the national authorities. The method of transmittal shall be agreed upon by the applicable parties.

The person authorized to compile the technical documentation:

Name: Dominik Kania, Managing Director
Address: Woodward Poland Sp. z o.o., ul. Skarbowa 32, 32-005 Niepolomice, Poland

This product must not be put into service until the final machinery into which it is to be incorporated has been declared in conformity with the provisions of this Directive, where appropriate.

The undersigned hereby declares, on behalf of Woodward Inc. of Loveland and Fort Collins, Colorado that the above referenced product is in conformity with Directive 2006/42/EC as partly completed machinery:

MANUFACTURER

Signature

Joseph Driscoll
Full Name

Engineering Manager
Position

Woodward Inc., Fort Collins, CO, USA
Place

5/4/17
Date

Document: 5-09-1182 (rev. 17)

Released

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 26815.

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Email and Website—www.woodward.com

Woodward has company-owned plants, subsidiaries, and branches, as well as authorized distributors and other authorized service and sales facilities throughout the world.

Complete address / phone / fax / email information for all locations is available on our website.