WOODWARD

Product Manual 35035
(Revision A, 3/2017)
Original Instructions

QuickTrip
Electro-Hydraulic Trip Block Assembly
P/N: 9907-1248

Reliability Manual

Revisions

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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.

This manual is intended to provide supplementary reliability information for this product and is NOT intended to supersede or replace the appropriate installation and operation manual for this product. For complete installation, operation and safety information concerning this product, please consult the appropriate installation and operation manual.

Safety Symbols

Direct Current

Alternating Current

Both Alternating and Direct Current

Caution, risk of electrical shock

Caution, refer to accompanying documents

Protective conductor terminal

Frame or chassis terminal

Chapter 1.
General Information

Introduction

This manual provides supplementary reliability information pertaining to Woodward's newest turbine safety product offering, the QuickTrip trip block. The information contained in this manual is intended to be used by the gas and steam turbine industry to understand the benefits this design can offer in applications using a hydraulic trip system requiring a high level of reliability and safety.

QuickTrip Information

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. The QuickTrip's triple-redundant, 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.

QuickTrip's benefits:

- Proven Technology
- SIL-3 Certified
- High Dirt Tolerance
- Designed for Long Life
- Triple-Redundant
- 2 out of 3 Voting
- Fast Response (<50ms, loss of control signal to valve open position)
- On-Line Testable (when used with compatible logic solver)
- On Line Repairable
- Failsafe Operation (fail open)
- Local Visual Position Indication
- Remote Position Feedback
- Compatible with Mineral and Synthetic Based Hydraulic Fluid
- Available for North American Class I, Div 1 and Class I, Div 2 and European Zone 1 and Zone 2

Note: For additional information, consult the QuickTrip Installation and Operation Manual B26815.

Chapter 2.
Design and Technology Similarity

Introduction

The design of QuickTrip is physically very similar to two Woodward products already in production. These are the CPC II and the VariStroke I products. This chapter provides a comparison in the technical similarities and differences between these products.

The CPC II Product is an electro-hydraulic pressure regulating valve control designed for use in positioning single-acting steam turbine valve servos.

The VariStroke I Product is a linear electro-hydraulic actuator that is designed to provide the linear actuation force to operate steam turbine control valves or valve racks.

Between these two products, Woodward has an extensive pedigree with 3500 units shipped to the field to date. Table 1-1 below provides a comparison of the components and technology used in the QuickTrip design as compared to the CPC II and VariStroke I products.

Table 2-1. Technical Comparison; QuickTrip and CPC II/VariStroke I

Technology	CPC II	VariStroke I	Comment
Rotating Inner Spool Type Valve Element	○	●	QuickTrip uses the same rotating, hollow spool valve technology as used in VariStroke I. This technology provides for low actuation forces, high flow, and high dirt tolerance. The spools used in QuickTrip are made of corrosion resistant stainless steel.
Outer Sleeve Element	○	●	The sleeves used in QuickTrip are made of corrosion resistant stainless steel.
Dual Shaft Bearings	●	●	QuickTrip uses the same bearings as used in VariStroke I
Shaft Seals	●	●	QuickTrip uses the same seals as used in both CPC II and VariStroke I
Valve Actuation (LAT Stator Coil/Magnetic Rotor)	●	●	QuickTrip uses the same LAT technology as used in CPC II and VariStroke I, but uses a larger LAT for larger actuation force
Failsafe Return Spring	●	●	The QuickTrip return spring uses the same power spring technology as used CPC II and VariStroke I, but uses a thicker spring material which provides higher torque for failsafe operation
Printed Circuit Assembly	○	○	The QuickTrip PCBA is a simpler design than CPC II and VariStroke I with no active components
Threaded Top Cover	○	○	Each product uses a threaded top cover that encloses the actuator cavity and provides explosion protection between the actuator and external environment

Technology	CPC II	VariStroke I	Comment
Hydraulic Connections	○	●	QuickTrip and VariStroke I both use 1.25” Code 61 type hydraulic flanges
Conduit Connections	●	●	All use ¾” NPT conduit ports
Sight Window			This is a new component for QuickTrip • Max design pressure 100 bar • Testing performed: ❖ Cyclic thermal testing (-40°C to +85°C) ❖ Impact testing per CSA C22.2, No 30-M1986, section 6.2 ❖ Thermal shock testing per EN 60079-0, Section 26.5
Legend: ● = Same Technology ○ = Similar Technology			

Chapter 3.
SIL Safety Rating

The QuickTrip design has been independently evaluated and tested by TUV to meet the following European standard for functional safety of safety-related systems and has been found to be suitable for use in a safety instrumented system up to SIL 3:

- IEC 61508 Parts 1-2 and 4-7:2010
- IEC 61511 Parts 1-3:2004 (in extracts)

Because of QuickTrip's triple-redundant design, the unit has a hardware fault tolerance of one, meaning any single failure within the QuickTrip will not cause a turbine shutdown.

Additional information:

PFD_{Avg}: 9.44 E -06
MTBF: 4,950,000 hours
$MTBF_D$: 70,600,000 hours

Product life up to 20 years (+1.5 years of storage) is acceptable without maintenance given adequate proof test cycles.

Definitions:

PFD_{Avg}:	Probability of Failing upon Demand
MTBF:	A measure of time between failures that causes a complete process shutdown
$MTBF_D$:	Same as MTBF, but refers specifically to failures that would result in a dangerous condition

Chapter 4.
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 (babbitt, ammonia, etc.) 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 environments. Its corrosion-resistant materials, rotary valve design, and self-cleaning ports allow it to operate without experiencing undesirable sticking or dragging. Additionally, 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 is improved.

QuickTrip was specifically tested and verified to operate in very dirty environments. Validation testing was conducted with hydraulic fluid containing contamination consisting of iron oxides and Arizona road dust. During the testing, QuickTrip experienced no failures to trip to a safe state. Below are photos of the contamination sample and components after testing was completed.

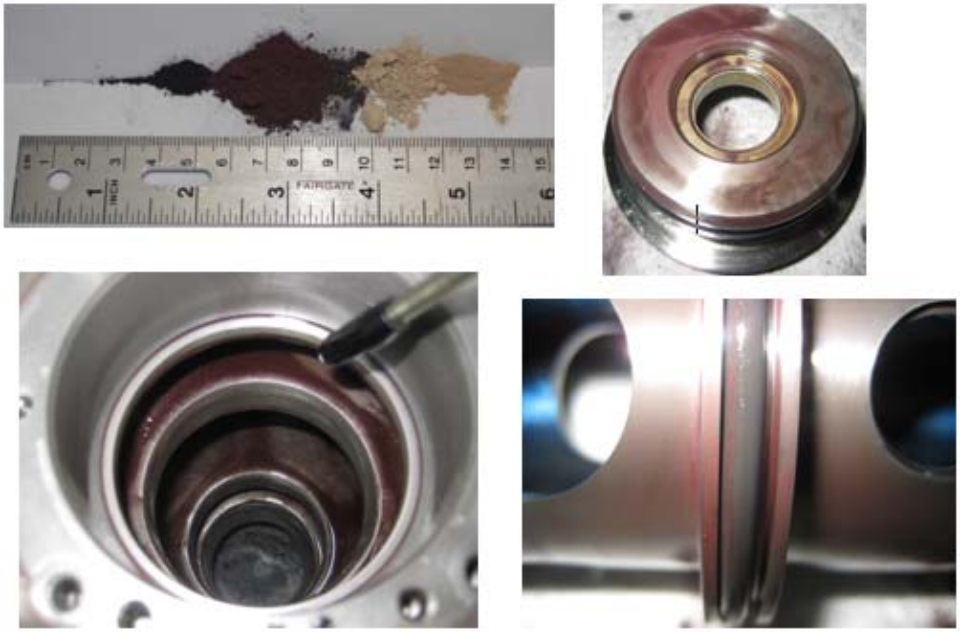

Figure 4-1. Contamination Test Photos

Chapter 5.
Endurance Life Testing

QuickTrip was designed and tested to meet a design life of 20 years. Endurance Life testing was performed on QuickTrip to verify it meets the stringent operating conditions typical of use in an industrial environment and to ensure it meets the stated design life. Assuming 1 trip per day (on-line diagnostic test), QuickTrip will experience 7300 trips in 20 years of useful life. Validation testing included performing a total of 21,000 trip cycles on the unit, with maximum operating hydraulic pressure at both high and low temperature extremes. This testing represents nearly 3x the typical lifespan of the QuickTrip unit. QuickTrip easily passed testing with all components operating within specification and with QuickTrip continually actuating to an energized (closed) state and returning to a de-energized (open) state when commanded.

This same unit was subjected to further endurance testing by performing an additional one million trip cycles in an effort to determine the endurance margin of the design. Once again, the unit continued to actuate to an energized (closed) state and return to a de-energized (open) state when commanded after logging more than 1 million cycles. At the conclusion of the test, the valve was disassembled and the valve spools, sleeves, rotation stops, return springs, magnetic rotor, and bearings were all inspected for additional wear. The parts endured the testing without any indication of abnormal wear. At a rate of one trip cycle per day, this test represents over 2700 years of operation, demonstrating a robust design.

Shock and Vibration Testing

QuickTrip validation testing included running shock, and vibration testing on the unit. The profiles used, listed below include running the unit, powered on and energized.

Shock

US MIL-STD-810C method 516.2, procedure 1 (10G Peak, 11ms duration, saw tooth waveform, X, Y, Z axis) / MS1 per Woodward 3-04-623

Vibration

US MIL-STD 810F, M514.5A, Cat. 4 (0.015G2/Hz, 10-500Hz, 1.04 Grms) / RV5 per Woodward 3-04-6231 (2 hours per axis)

QuickTrip easily passed the testing with no component failures or premature wear and the unit experienced no spurious/undesired trips.

Chapter 6.
On-Line Testability and Reparability

On-Line Testability

When packaged with a Woodward ProTechTPS safety logic solver (or MicroNet Safety Module), the ProTechTPS can be configured to automatically perform the required routine safety system diagnostic tests to verify unit operation while the turbine is on-line. The proof test trip time response monitoring and logging ensures the total turbine safety system can respond fast enough to safely shutdown the turbine. Online testing provides the following benefits:

- Regular unit health checks
- Early failure detection
- Trip time performance trending

On-Line Reparability

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. This repair can be performed on-line since the module electrical enclosures are physically isolated from each other.

The following QuickTrip parts are on-line repairable*

- Solenoid Coil (LAT)
- Electronics Module (PCBA with position sensors)
- Top Cover/Sight Window
- Bottom Cover/Return Spring
- Rotor

*Circuits for the module under repair must be de-energized

Figure 6-1. On-Line Repair Photos

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.

Revision History

Changes in Revision A—

- Inserted new paragraph in Chapter 5 pertaining to Million Cycle Test Information

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We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 35035.

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