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**TÜV Rheinland Group**

**Automation, Software and Information Technology**

**Test report about the type approval  
safety-related automation devices  
Tricon Version 10  
Triconex Invensys Systems Inc.**

**Report-No.: 968/EZ 105.04/05  
Date: 2005-08-15**

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**Pages:  
(excluding appendices)** 8

**Test object:** Tricon Version 10

**Customer/Manufacturer:** Triconex Invensys Systems Inc.  
Invensys Systems, Inc.  
15345 Barranca Parkway  
USA-Irvine, California 92618  
United States of America

**Order-No./Date:** 109880 dated 2004-12-15

**Test Institute:** TÜV Industrie Service GmbH  
Automation, Software, Information Technology (ASI)  
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**TÜV-Offer-No./Date:** -

**TÜV-Order-No./Date:** 9184657 dated 2004-12-16

**Inspector:** Dipl.-Ing. Wolfgang Velten-Philipp

**Test location:** See Test Institute

**Testing duration:** July 2005

The test results exclusively relate to the test objects.

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<b>Table of content</b>		<b>Page</b>
1	Scope	4
2	Standards	4
3	Object of inspection	5
3.1	Test documentation	5
3.1.1	Manufacturer's documentation	5
3.1.2	User documentation	6
3.1.3	Test Institute documentation	6
4	Safety requirements	6
5	Results type approval	6
5.1	System description	6
5.2	Measures to avoid failures	6
5.3	Specification and Architecture	7
5.4	FMEA and fault injection	7
5.5	Reaction times	7
5.6	Calculation of the probability of failure on demand	7
5.7	Programming environment	7
5.8	Electrical safety tests	7
5.9	Electromagnetic compatibility and environmental simulation tests	7
6	Summary	8

## 1 **Scope**

Scope of this report is the type approval of the TRICON Communication Modules (TCM) and the related PLC firmware changes. The type approval shows that the modules are developed in accordance with the standards listed in chapter 2.

This report supports the certificate no.: 968/EZ 105.04/05 for the safety related programmable logic controller TRICON version 10.0. This version enables the PLC to operate the newly developed TRICON Communication Module (TCM).

## 2 **Standards**

### **Functional Safety**

- [1] IEC 61508:2000, parts 1 - 7  
Functional safety of electrical/electronic/programmable electronic safety related systems

### **Electrical safety and resistance against environmental conditions**

- [2] IEC 61131-2:2003  
Programmable Controllers  
Part 2: Equipment requirements and tests

### **Electromagnetic Compatibility**

- [3] EN 61000-6-2:2001  
Electromagnetic Compatibility (EMC)  
- Generic Standards  
- Immunity for Industrial Environments
- [4] EN 61000-6-4:2001  
Electromagnetic Compatibility (EMC)  
- Generic emission standard  
- Residential, commercial, and light industry

### **Application specific standards**

- [5] ISA S84.01  
Application of safety instrumented systems for the process industry
- [6] IEC 61511, parts 1-3: 2004  
Functional safety  
Safety instrumented systems for the process industry sector
- [7] DIN VDE 0116:1989  
Electrical Equipment of Furnaces
- [8] EN 50156-1:2004  
Electrical Equipment for Furnaces  
Part1: Requirements for application Design and Installation
- [9] NFPA 85:2001  
Boiler and Combustion Systems Hazards Code

[10] EN 54-2:1997  
Fire detection and fire alarm systems  
Part 2: Control and indicating equipment

[11] NFPA 72:2002  
National Fire Alarm Code

### 3 **Object of inspection**

Test objects are the Tricon TCM modules model 4351, 4352 and firmware version build 76. Purpose of the TCM modules is to replace the existing Tricon ICM and NCM modules. The TCM modules allow the PLC to communicate via industry-standard protocols, it implements a TCP/IP stack and is prepared for OPC.

TCM allows furthermore safety related peer to peer communication between safety related Tricon systems and modules.

Scope of the approval are

- The TCM modules and the TCM module firmware
- The Tricon firmware changes
- The modifications of the Tristation programming tool to allow programming and use of the TCM module.

### 3.1 **Test documentation**

#### 3.1.1 **Manufacturer's documentation**

H1	Triconex V10 System Verification Document List.xls Filelist on CD_ROM dated 2005-11-28
H2	9100092-001 TRICON V10.0 AND V10.1 Engineering Project Plan
H3	Tricon V10.0 ETSX and IOCCOM (TUV) Change Impact Analysis and Test Report, 2005-06-27 9600127-005 TS1131 (TUV) Impact Analysis and Test Report, 2005-07-26 9100090-001 TS1131 v4.1 Overview of changes and Impact analysis.doc, 2004-12-22
H4	TCM System Requirements Specification 6200152-001 V1.3 released 7/25/05 TCM System Architecture Specification 6200152-002 V1.5 released 7/25/05
H5	TCOM Software Requirements Specification 6200152-003 v1.2 released 7/25/05 TCOM Software Design Specification 6200152-004 v1.2 released 7/25/05
H6	TCM Hardware Requirements Specification 7100281-100 V1.0 released 7/28/05 TCM Hardware Design Specification 7100281-001 V1.2 released 7/28/05
H7	FMEA (TCM Module FMEA) 9100089-001 Vx.1 Tricon FMEA.doc (System Level)

H8	TRICON COMMUNICATION MODULE (TCM) MANUAL FAULT INSERTION TEST REPORT JULY 27, 2005, REVISION 3
H9	Verification Test Report for TS1131 V4.1.420 9600127-005 was released 7/26/05

### 3.1.2 User documentation

B1	9720097-002 Safety Considerations Guide, Tricon v9-v10 released 6/15/05
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### 3.1.3 Test Institute documentation

P1	Report-No.: 968/EL 226.00/05, TÜV Rheinland
P2	Report-No.: 968/EZ 105.03/01, TÜV Rheinland

## 4 Safety requirements

The safety related Tricon PLC is intended to be used in safety related loops up to SIL 3.

The TCM allows non safety related communication using industry-standard protocols. In case of safety related peer to peer communication between different Tricon PLCs or modules the TCM acts as black channel for the safety related messages. In every case the TCM is interference free for the safety related parts of the Tricon system.

## 5 Results type approval

### 5.1 System description

The TCM communication module has its own microcontroller structure and has no direct access to main processor memory locations. All information transmitted to the main processor is polled by main processor firmware. Therefore the main processor has fully control over all data transfer activities. The TCM communication is completely interference free for the main processor firmware.

Note: On application level the user is responsible for correct use of non-safety related data in a safety related application.

### 5.2 Measures to avoid failures

The manufacturer created a plan [H2] which describes the complete test sequence. Furthermore a change and impact analysis was performed to evaluate the impact of software modifications on the Tricon PLC firmware [H3]. The Test Institute reviewed those changes on the basis of the test analysis and the corresponding documentation.

The documentation is compiled in an documentation plan [H1].

The measures to avoid faults are suitable for the required SIL 3 according to IEC 61508.

### 5.3 Specification and Architecture

There are specifications on system level [H4], for hardware [H6] and for software [H5]. The specifications are defining the requirements and on lower level the implementation details. For requirements tracking purposes a appropriate tool was used during the project.

### 5.4 FMEA and fault injection

The original FMEAs and corresponding fault injection tests were adapted to the changes made and were reviewed [H7].

The review of the FMEAs and the fault injection tests [H8] were closed with positive results.

### 5.5 Reaction times

System reaction times of the Tricon PLC are not affected by TCM communication.

### 5.6 Calculation of the probability of failure on demand

The TCM communication module does not affect the PFD or PFH of the Tricon PLC system.

### 5.7 Programming environment

The Tristation workbench was updated to integrate the TCM module. The TCM can be used in conjunction with Tristation V4.1 and higher.

### 5.8 Electrical safety tests

EN 61131-2 has been used for electric safety testing. The tests performed are documented in the protocols [P1].

All products are supplied with SELV (Safe Extra Low Voltage) in accordance with [5] and laid out for SELV with respect to isolation.

### 5.9 Electromagnetic compatibility and environmental simulation tests

Tests were performed in accordance with the following standards:

- EN 61131-2
- EN 61000-6-2
- EN 61000-6-4
- DIN VDE 0116/EN 50156-1
- EN 54-2

The tests have been performed by accredited test laboratories and have been recognized by the Test Institute.

During the tests, the safety-related system properties have been monitored.

The environmental simulation tests have been documented in test report [P1]

**6**      **Summary**

The tests performed have demonstrated that the TCM module is interference free for safety related applications.

The report-no.: 968/EZ 105.03/01 for TRICON version 9.6 remains valid.

Application programs must be created using the Tristation V4.1 and higher and be conform to the guidelines specified in the safety manual.

All conditions, which the user must comply with for safely using the products, are described in detail in the corresponding safety manuals.

The actual valid hardware and software versions should be retrieved from the currently valid module and firmware release list. The list is released together by the manufacturer and the Test Institute.

Cologne, 2005-08-15  
TIS/ASI/Kst. 968 vt-nie

The expert

A handwritten signature in black ink, appearing to be 'W. Velten-Philipp'.

Dipl.-Ing. Wolfgang Velten-Philipp