



Product Service

CERTIFICATE

No. Z10 14 02 60643 007

Holder of Certificate: **RTP Corporation**
2832 Center Port Circle
Pompano Beach FL 33064
USA

Factory(ies): 60643

Certification Mark:



Product: **Safety Related Programmable Electronic System**

Model(s): **RTP3000 TAS**

Parameters:

Option 1:	
Operating Voltage:	18-36VDC
Input Current:	Less than 10A
Option 2:	
Operating Voltage:	85-264VAC, 47-63Hz
Input Current:	Less than 4A
Operating Temperature:	-20°C to +60°C

Tested according to:

- IEC 61508-1:2010 (SIL 1-3)
- IEC 61508-2:2010 (SIL 1-3)
- IEC 61508-3:2010 (SIL 1-3)
- IEC 61508-4:2010 (SIL 1-3)
- IEC 61511-1:2003 (SIL 1-3)
- IEC 61131-6:2012 (SIL 1-3)
- NFPA 72:2013
- NFPA 85:2011
- EN 54-2:1997

The product was tested on a voluntary basis and complies with the essential requirements. The certification mark shown above can be affixed on the product. It is not permitted to alter the certification mark in any way. In addition the certification holder must not transfer the certificate to third parties. See also notes overleaf.

Test report no.: RP85295C

Date, 2014-02-07 (Peter Weiss)



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Zertifizierungsvertrag

Grundlage für die Zertifikatserteilung ist die Prüf- und Zertifizierungsordnung von TÜV SÜD Product Service.

Mit Erhalt des Zertifikates erkennt der Zertifikatsinhaber die jeweils gültige Fassung der Prüf- und Zertifizierungsordnung an (www.tuev-sued.de/ps_regulations) und wird somit Partner im Zertifizierungssystem von TÜV SÜD Product Service.

Prinzipielle Voraussetzung für die Gültigkeit des Zertifikates:

- Gültigkeit der zitierten normativen Prüfgrundlage(n) ist gegeben
- und zusätzlich bei Zertifikaten mit Berechtigung zur Verwendung eines Prüfzeichens bzw. bei Zertifikaten für QM-Systeme:
- Voraussetzungen für vorschriftsmäßige Fertigung werden eingehalten.
 - Die Fertigungs- bzw. Betriebsstätten werden regelmäßig überwacht.

Certification contract

Certification is based on the TÜV SÜD Product Service Testing and Certification Regulations.

On receipt of the certificate the certificate holder agrees to the current version of the Testing and Certification Regulations (www.tuev-sued.de/ps_regulations) and thus becomes partner in the TÜV SÜD Product Service Certification System.

Requirements for the validity of the certificate in principle:

- Validity of the quoted test standard(s)
- In addition for certificates with the right to use a certification mark and for QM certificates:
- Conditions for an adequate manufacturing are maintained
 - Regular surveillance of the facility is performed

Akkreditierungen / Benennungen (Status 25.02.2010) /
Accreditations / notifications (as of 2010-02-25)

Deutschland / Germany

Geräte- und Produktsicherheitsgesetz (GPSG) /
Equipment and Product Safety Act (GPSG)

Europa / Europe

- Niederspannungsrichtlinie 2006/95/EG
- Spielzeugrichtlinie 2009/48/EG
- Richtlinie für aktive medizinische Implantate 90/385/EWG
- Richtlinie für Medizinprodukte 93/42/EWG
- Richtlinie für In-vitro-Diagnostika 98/79/EG
- Richtlinie für Gasverbrauchseinrichtungen 90/396/EWG
- Richtlinie für persönliche Schutzausrüstungen 89/686/EWG
- EMV-Richtlinie 2004/108/EG
- Richtlinie für Sportboote 94/25/EG + 2003/44/EG
- Richtlinie für Maschinen 2006/42/EG
- Richtlinie für Ex-Schutz Geräte 94/9/EG

- Low Voltage Directive 2006/95/EC
- Toys Directive 2009/48/EC
- Directive for Active Implantable Medical Devices 90/385/EEC
- Directive for Medical Devices 93/42/EEC
- Directive on In Vitro Diagnostic Medical Devices 98/79/EC
- Directive for Gas Appliances 90/396/EEC
- Directive for Personal Protective Equipment 89/686/EEC
- EMC Directive 2004/108/EC
- Directive for Recreational Craft 94/25/EC + 2003/44/EC
- Directive for Machinery 2006/42/EC
- Directive for Ex Safe Equipment 94/9/EC

- ENEC Agreement for luminaires and IT equipment

USA

- Nationally Recognized Testing Laboratory (NRTL) to 29 CFR 1910.7 by OSHA
- Accredited for FDA 510(k) Third Party Review
- Conformity Assessment Body to the MRA for Medical Devices; FDA QSR Reg Inspections, FDA 510(k) Third Party Review

Asien-Pazifik Region / Asia Pacific

- Recognized Certification Body to Electrical Products (Safety) Regulation; Hong Kong
- Konformitätsbewertungsstelle / Conformity Assessment Body to the MRA for Medical Devices; Australien / Australia
- Konformitätsbewertungsstelle / Conformity Assessment Body to the MRA for Medical Devices; Neuseeland / New Zealand

Weltweit / Worldwide

- NCB im CB-Scheme des IECEE / NCB in the CB Scheme of IECEE
- ExCB im IECEX-Scheme des IECEE / ExCB in the IECEX Scheme of IECEE
- TÜV SÜD Product Service Mark für Produkte / TÜV SÜD Product Service Mark for products DAP-ZE-1213.00
- Zertifizierung von QMS / Certification of QMS TGA-ZM-08-93-00
- Zertifizierung von QMS gemäß / Certification of QMS according to (DIN) EN ISO 13485 / ISO 13485



Report
on the
Certificate
Z10 14 02 60643 007
RTP3000 TAS

Manufacturer:

RTP Corporation
2832 Center Port Circle
Pompano Beach
Florida 33064
USA

Report no. RP85295C
Revision 1.3 of 2014-03-31

Test Body
TÜV SÜD Rail GmbH
Generic Safety Systems
D-80339 Munich

Certification Body
TÜV SÜD Product Service GmbH

D-80339 Munich



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Revision

Version	Status	Date	Author	Changed chapters	Reason of change
1.0	initial	2013-12-17	J. Dong		Initial
1.1		2013-12-20	K. Leupold		corrections
1.2		2014-02-07	K. Leupold		NFPA 72, 85 added
1.3		2014-03-31	J. Dong		certificate number updated

Table 1: Revision

1 Target of Evaluation (ToE)

In March 2013 the company RTP Corporation assigned TÜV SÜD Rail GmbH for testing and certifying of the RTP3000 TAS according to SIL 3 according to IEC 61508 series.

2 System overview

2.1 Description

The RTP3000 TAS systems is a safety-related programmable system suitable for safety-related applications with a high level of potential danger e. g. Emergency Shutdown Systems (ESD), Burner Management Systems (BMS), Fire and Gas Detection Systems (F&G), Turbine Control Systems, etc.

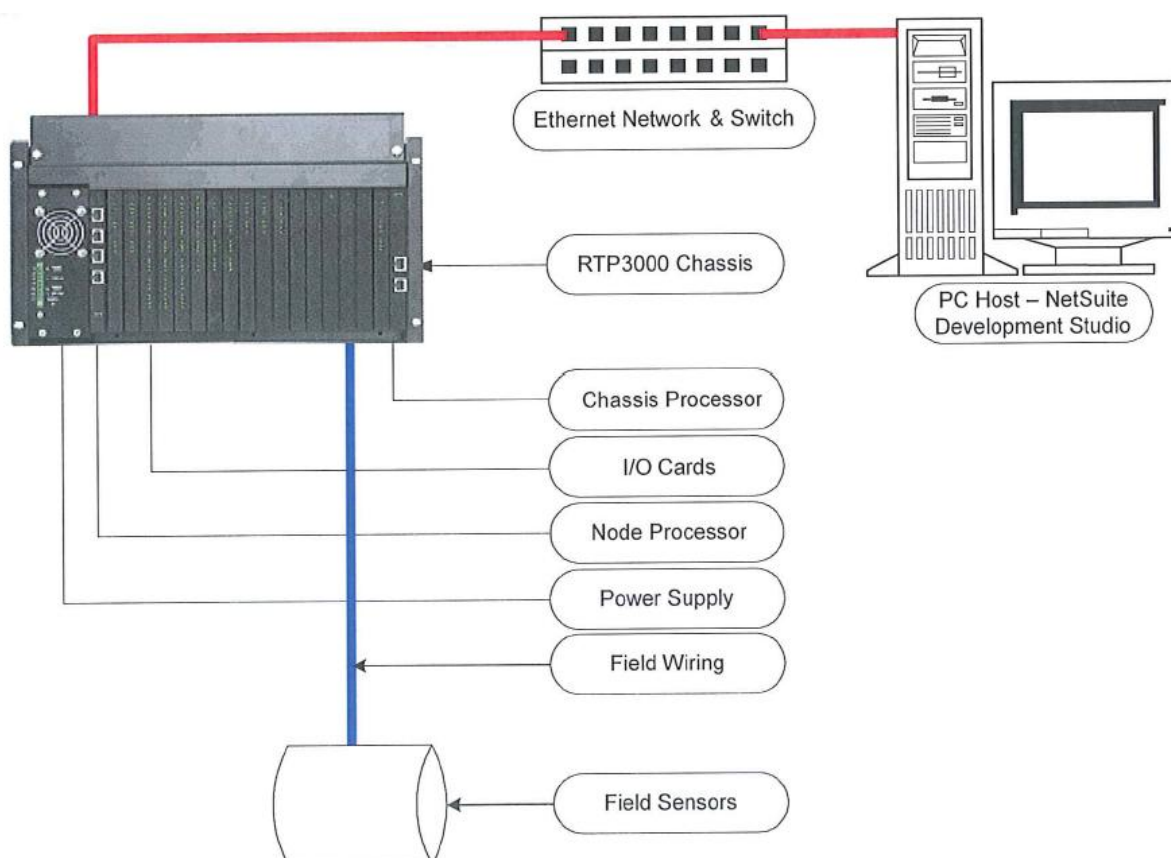


Figure of RTP3000 System

The basic RTP3000 TAS system consists of a hardware chassis, a power supply, a node processor card, a chassis processor card and any optional input/output cards.



2.2 Test specimen

2.2.1 Processor

The processor node could include safety related and non safety related library modules in an application, whereas the safety instrumented functions should be built up in a user application program while using the certified subset of the graphical languages.

Each node processor executes two copies of the user application program (PGM). I/O scanning of the processor is performed at the same point during program execution, using the same input data for both application programs. The outputs of each of the PGM are compared before sending them to the Chassis Processor.

The node processor of the RTP3000 TAS system is configurable in simplex (RTP3000S), dual redundant (RTP3000D), TMR architecture (RTP3000T) and quad redundant architecture (RTP3000Q).

2.2.2 I/O Modules / Components

An I/O card is the component that provides basic I/O capabilities between the RTP system and field sensors/signals. The I/O itself will be performed asynchronously. All safety rated input cards and safety rated analog output cards shall satisfy SIL 2 requirements, some of them satisfy SIL 3 requirements. SIL 3 requirement for SIL 2 modules shall be accomplished by means of redundant architectures.

The I/O racks, and their installed I/O cards, can be organized as common (non-redundant) I/O racks, redundant I/O rack pairs, or redundant I/O triplets to match the required availability.

2.2.3 Safety configuration

The safety application programming software “NetArrays Developer Studio” is able to configure safety related PES nodes and safety I/O modules as well as non-safety PES nodes and non-interfering I/O modules.

2.2.4 Safety application programming

The application programming software “NetArrays Developer Studio” contains a SIL-certified subset of the graphical languages as previously implemented by RTP Corp. to give the opportunity for users to build up their PGM. The safety application programming environment compiles the application project and checks for errors and mistakes.

The conditions and rules for safe use of the RTP3000 TAS series are laid down within the user documentation.

2.2.5 Communication Component Relationships

1. I/O data is transferred between I/O cards and the RTP 3000 Node Processor card: In an RTP3000 SIS, I/O data is passed between an I/O card and the chassis processor via the chassis back-plane bus. The chassis processor card communicates I/O data with the RTP3000 Node Processor card via Ethernet messages which can either be wired port to port or through a separate Ethernet network. This network can be configured redundantly.



2. Intercommunication data is managed between redundant RTP3000 Node Processor cards: In an RTP3000SIS, intercommunication data is passed between RTP3000 Node Processor cards via Ethernet messages which can either be wired port to port (a dual redundant scenario) or through a separate Ethernet network (a triple redundant scenario). This network cannot be redundantly configured.
3. Peer-to-peer communication data is managed between RTP2300, RTP2300M, RTP2500, RTP2500M and RTP3000 Node Processor cards via an Ethernet network using TCP/IP messages.
4. Host communication data is managed between an RTP3000 Node Processor card and a host PC via an Ethernet network using TCP/IP messages. Host PC applications can be either RTP NetSuite or a 3rd party HMI software package communication via RTP communications protocol or an OPC interface utilizing the RTP communications protocol.

2.2.6 Basis System Availability and Redundancy

Triple and quad redundancy for the safety-related programmable system RTP3000 TAS increases availability without having influence onto the safety of the system. Techniques and measures are included to allow switching from a faulty module to the standby module within a time that allows carrying on the process in a safe manner without interruption. An overview of the reachable safety integrity levels in redundant and non-redundant mode can be seen in the related manuals.

	RTP3000S RTP3000M (Non-redundant I/O)	RTP3000D, RTP 3000T RTP 3000Q (Non-redundant I/O)	RTP3000D, RTP3000T RTP3000Q (Redundant I/O)
Availability	Normal	High	Very High
Controller Module	Mono	Redundant	Redundant
I/O Module	Mono	Mono	Redundant
I/O Bus	Mono	Mono	Redundant

2.2.7 Hardware Components under Certification

Beside the above mentioned certified hardware modules the systems consist of non safety-related hardware. These non-interfering I/O cards shall be able to be inserted into the same chassis as with the safety-certified I/O cards. These non-interfering hardware modules may only be used for the processing of signals not relevant to safety and not for the processing of safety-related tasks.

2.2.8 Fault Reactions of the System

System behavior in all possible architectures of all component types, like Processor Nodes, Chassis Processors (including communication) and I/O Modules is described in the Architectural Design Specification. See also Annex of the report to the certificate RP85295C in the current version.



3 Certification Requirements

3.1 Basis of Certification

The certification of the RTP3000 TAS will be according to the regulations and standards listed in clause 3.3 to 3.6 of this document. This will certify the successful completion of the following test segments:

- I. Functional safety
 - Analysis of the system structure (FMEA system)
 - Analysis of the hardware (FMEA component, quantitative analysis)
 - Analysis of the software
 - Fault simulations and software tests
 - Test of the fault prevention measures
 - Functional test
- II. Electrical safety
- III. Susceptibility to environmental errors
 - Climate and temperature
 - Mechanical effects
- IV. Electromagnetic compatibility
- V. Safety information in the product documentation (safety manual, operating instructions)
- VI. Product-related Quality Management in manufacturing and product care.

Certification is dependent on successful completion of all above listed test segments. The testing follows the basic certification scheme for Safety Components of TÜV SÜD Rail GMBH.

3.2 Certification Documentation

- Technical Report by TÜV SÜD Rail GmbH
Report No. RP85294T
- Safety Manual - 3000 Series – Safety Instrumented Systems
- Reference Manual – NetArrays I/O Card Configuration Properties
- User Guide - RTP NetSuite Safety Instrumented System Development
SoftwareUser
- Technical Manuals (provided for each component)

Based on the specified purpose of use of the RTP3000 TAS in safety critical process applications, the certification is based on the following set of standards. The issuance of the certificate states compliance with these references unless specifically noted otherwise.



3.3 Functional Safety

The testing for functional safety is to be performed using the following standards and guidelines:

IEC 61508/ EN 61508 part 1 –4: 2010 (SIL3)	Functional safety of electrical/electronic/programmable electronic safety-related systems
IEC 61131 –6: 2012 (SIL3)	Functional safety

3.4 Basic Safety and Environmental Safety

To complete and to specify the technical requirements resulting from the essential requirements of the directives listed above the testing of Basic Safety is to cover the following standards:

EN 61131-2: 2007	Programmable controllers – equipment requirements and tests
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3.5 Electromagnetic Compatibility

To complete and to specify the technical requirements resulting from the essential requirements of the directives listed above, the testing of Electromagnetic Compatibility is to cover the following standards:

EN 61131-2: 2007	Programmable controllers – equipment requirements and tests
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3.6 Application

EN 54-2: 1997	Fire detection and fire alarm systems - Part 2: Control and indicating equipment
IEC 61511-1: 2003	Functional Safety: Safety Instrumented Systems for the process industry sector
NFPA 72: 2013	National fire alarm and signalling code
NFPA 85: 2011	Boiler and combustion systems hazards code



4 Results

4.1 Functional Safety

The tests performed and quality assurance measures implemented by the manufacturer have shown that the RTP3000 TAS complies with the testing criteria specified in clause 3 subject to the conditions defined in clause 5 and its subsections, and is suitable for safety-related use in applications up to SIL 3 in accordance with EN/IEC 61508.

4.1.1 Fault Reaction and Timing

Fault detection in the RTP3000 TAS is assured by means of following basic techniques:

- self test at power up and during operation
- two channel control logic with cross check
- redundancy
- normal and inverted signal processing within the I/O cards

4.1.2 Evaluation of fault prevention measures

For the avoidance of failures the following techniques and measures were used:

- Project management
- Documentation
- Structured specification
- Inspection of the specification or walk-through of the specification
- Observance of relevant guidelines and standards
- Structured design
- Modularization
- Use of well tried components
- Inspection of the hardware
- Functional testing (also under environmental conditions)
- Operational and maintenance instructions
- User- and maintenance friendliness

The individual measures for the avoidance of failures provide the required degree of effectiveness and are specified in the relevant documents

4.1.3 Analysis of the hardware safety integrity and hardware fault simulations (FIT)

The Failure Mode Effect and Diagnostic Analysis (FMEDA) showed that the occurrence of a single fault do not lead to loss of the safe functioning. The individual architectural constrains are sufficient and their corresponding degree of fault detection provide the required degree of effectiveness.

The response time to safety critical faults shall be determined application specific in accordance to the safety manual.



4.2 Basic Safety and Electromagnetic Compatibility

4.2.1 Electrical Safety

The results about the electrical safety are documented by the certificates and test reports of an accredited test centre. The documentation of the tests has been reviewed for completeness.

These certificates show that the standards specified in clause 3 are covered.

4.2.2 Environmental Testing

The environmental stress tests are documented by the certificates of an accredited test centre.

The above mentioned certificates and tests and the quality assurance measures implemented by the manufacturer have shown that the RTP3000 TAS comply with the testing criteria specified in clause 3 subject to the conditions defined in clause 5 and its subsections.

4.2.3 Electromagnetic Compatibility

The tests of the electromagnetic compatibility are documented by the certificates and test reports of an accredited test centre. The documentation of the tests has been reviewed for completeness.

These certificates show that the standards specified in clause 3 are covered.

4.3 Product Specific Quality Assurance and Control

The software and hardware components developed and manufactured in course of the safety evaluation are governed by RTP Corp. quality assurance and control system.

As part of the certification process TÜV Product Service also performs a procedure that is tailored to the assessed product in order to assess the consistency of product quality while accounting for product modifications and their identifiability (follow-up service).

5 Implementation Conditions and Restrictions

The use of the RTP3000 TAS shall comply with the current version of the safety parts of the user manual, and the following implementation and installation requirements have to be followed if the RTP3000 TAS is used in safety-related installations.

5.1 General Application Conditions

- The guidelines specified in the instruction manuals shall be followed.
- Only modules certified for safety-related operation, as shown in the annex shall be used for safety-critical functions.

Not certified standard modules (defined as non-interfering) may be used for non-safety-critical signals only.

- The fault tolerance period of the process controlled by the system shall be greater than the worst-case response time of the system.



- A well-defined shutdown procedure shall be specified.
- Non-safety-related blocks in the application program shall not control or affect data used by any safety-critical block unless in case of plausibility checks in the safety-related program.

5.2 General Commissioning Conditions

- The guidelines and the instructions for commissioning, described in the instruction manual, have to be followed.
- Prior to commissioning, a complete functional test of all safety-relevant programmed application functions shall be performed.
- All timing requirements shall be validated.
- Any application software modification after commissioning shall result in a re-validation of the entire application software. The commissioning can be reduced if the change can be shown by use of a revision checker to be limited to a specific area of program.
- The proper fail-safe configuration of all safety-critical fail-safe I/O shall be verified. Only configurations covered by the Safety Manual are covered by the certification.

5.3 General Run-time Conditions

- The operating conditions as specified in the instruction manuals shall be met.
- The procedures of modification of safety related data and components described in the user manual have to be followed.
- The maintenance and repair instructions described in the instruction manual of the RTP3000 TAS have to be followed.
- Failed modules that are safety-related should be replaced as quickly as practical to minimize the probability of multiple fault accumulation and potential (safe) nuisance shutdown. As a maximum, failed modules should be replaced within the multiple fault occurrence time. The calculations of the Probability-of-Failure-on-Demand of the safety-related RTP3000 series system are documented in the report "Markov Model Analysis".



6 Certificate Number

This report specifies technical details and implementation conditions required for the application of RTP3000 TAS to the certificate:

Z10 14 02 60643 007

Munich, 2014-03-31

TÜV SÜD Rail GmbH
Rail Automation

A handwritten signature in blue ink, appearing to read 'Peter Weiß'.

Peter Weiß
(Technical Certifier)



Choose certainty.
Add value.

Technical Report

of

Modifications

Z10 14 02 60643 007

Safety Related Programmable System RTP3000 TAS

Applicant

RTP Corporation
2832 Center Port Circle
Pompano Beach
Florida 33064
USA

Manufacturer / Product Development

see referenced certificate

Report No.: RP93979T

Version 1.1 of 17.06.2019

related to

Technical Report: RP82451T
Order No.: 717517406

Test Body

TÜV SÜD Rail GmbH
Rail Automation
Barthstraße 16
D-80339 München

Certification Body

TÜV SÜD Product Service GmbH
Ridlerstraße 65
D-80339 München

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Revision History

Rev.	Status	Date	Author	Modification / Description
1.0	active	27.05.2019	P. Weiß / A.Valente	-
1.1	active	17.06.2019	P. Weiß	Formal updates

Table 1: Revision History

1 Summary of Modifications

On 2018-07 RTP Corporation (hereafter named “customer”) requested TÜV SÜD Rail GmbH to test and certify below listed modifications of RTP3000 TAS. The project number related to this modification is 717517406.

This report is based on the review results of the following modification subtasks:

Task	Modification Description
Subtask 1	New system controller card 3200T
Subtask 2	New Power Supply Module (AC / DC Version)
Subtask 3	New Chassis/Chassis Backplane
Subtask 4	New I/O Card (3142 - 8 Channel Pulse Input Card)
Subtask 5	New I/O Card (3144, 3145, 3146 - 16 Channel Analog Output Card)
Subtask 6	New I/O Card (3147 - 32 Channel Digital Input Card)
Subtask 7	New I/O Card – (3148, 3149, 3150, 3151, 3152 - 32 Ch Analog Input, 3153 - 32 Ch Digital Input)
Subtask 8	New I/O Card (3159 - 32 Ch Digital Output)

Table 2: Modification Description and Subtasks

2 Purpose of the Document

The report presents the review results of the modifications related to a certified product. Therefore the testing is restricted to the modification mentioned in section 1 and documented in section 3, regarding the standards listed in section 2.3.

2.1 Existing Certification Documentation

The Safety Related Programmable System RTP3000 TAS is already certified. The version and the results of testing performed by TÜV SÜD have been documented in:

Ref.	Document	Rep. No	Rev.	Date
/A1/	Z10 14 02 60643 007	-	-	2014-02-07
/A2/	Report to the Certificate	RP85295C	1.3	2014-03-31
/A3/	Technical Report on testing functional safety	RP85294T	1.2	2014-02-07
/A4/	Annex 1 of the report on the certificate	-	1.6	2018-06-04

Table 3: Existing Certification Documentation

2.2 Objectives

Based on the results of former testing activities (see section 2.1) of TÜV SÜD, the modifications (see section 1) of the RTP3000 TAS were examined in from July 2018 to June 2019.

The amount of the necessary activities and the phases of the existing safety lifecycle which need to be repeated are analyzed and documented from the customer and reviewed by TÜV SÜD.

2.3 Standards

Evaluation of the modifications was performed in accordance to the standards and guidelines mentioned in the Report referenced in the Table 3: Existing Certification Documentation above.

3 Documentation and Results of the Review

The following chapters provide information about the impact of the product modification.

Based on impact analysis from the customer TÜV SÜD Rail GmbH has assessed all mentioned modifications of the RTP3000 TAS.

The chapters 3.1 to 3.10 are treating more general aspects of the product, whereas the sub-chapters of chapter 3.11 are connected to subtasks, defined in chapter 1.

3.1 Functional Safety Management and Fault Avoidance Measures

During the approval of the relevant documentation for the described RTP3000 TAS modification the necessary functional safety management activities and lifecycle phases have been identified and agreed by TÜV SÜD Rail GmbH, see documented impact analysis from customer and related TÜV SÜD review listed in the tables of chapter 3.11.

3.2 System Failure Mode and Effects Analysis (System-FMEA)

The system safety concept hasn't been changed by the modification, whereas the technical report referenced in chapter 2.1 is still valid.

3.3 Quantitative analysis

see documented analysis from customer and related TÜV SÜD review listed in tables below

3.4 Electrical Safety

see documented analysis from customer in DVT documents and related TÜV SÜD review listed in tables below

3.5 Climatic stress tests

see documented analysis from customer in DVT documents and related TÜV SÜD review listed in tables below

3.6 Mechanical stress tests

Not applicable

3.7 Electrical stress tests

see documented analysis from customer in DVT documents and related TÜV SÜD review listed in tables below

3.8 Testing of the noise immunity

See /D8/

3.9 Testing of the noise emission

See /D9/

3.10 Verification of the degree of protection

Not applicable

3.11 Documents provided for testing

Following documents were provided by RTP Corporation to be checked and evaluated by the testing laboratory. Documents listed here are related to all changes:

No.	Title	Document number / ID	Rev.	Date
Project Planning				
/D1/	Impact Analysis	RTP Impact Analysis - 060_1	1.1	2019.03.01
Design				
/D2/	-	See below in section 3.11	-	-
Testing				
/D3/	Quantitative analysis	See below in section 3.11	-	-
/D4/	Electrical Safety	See below in section 3.11	-	-
/D5/	Climatic stress tests	See below in section 3.11	-	-
/D6/	Mechanical stress tests	See below in section 3.11	-	-
/D7/	Electrical stress tests	See below in section 3.11	-	-
/D8/	Testing of the noise immunity	NC72144691.1 Issue 2 Test Report	2	2019.02.11
/D9/	Testing of the noise emission	NC72144691.2 Issue 2 FCC Report	2	2019.02.11
/D10/	Verification of the degree of protection	See below in section 3.11	-	-
/D11/	SQA Test Specification and Plan	AE835-5005-002 SQA Test Specification and Plan	1	5/31/2019
Manuals				
/D12/	Technical Manual 3148 and 3149 Hart Enabled 32-Channel Analog Input Cards 3150 and 3151 32-Channel Current Analog Input Cards 3152 32-Channel Voltage Analog Input Cards 3153 32-Channel Supervised Digital Input Card	3148_3149_3150_3151_3152_ 3153 AI_SD1	-	5/22/2019

No.	Title	Document number / ID	Rev.	Date
/D13/	Reference Manual NetArraysModule Form andLadder Form Objects	Netarraysobjects	-	3/19/19
/D14/	Technical Manual 3200T Processor	3200T Processor	-	5/22/2019
/D15/	Technical Manual RTP 3000 TAS Chassis Manual	Chassis Manual	-	5/22/2019
/D16/	Technical Manual 3142 8-Channel Pulse Input Card	3142 Pulse Input	-	5/22/2019
/D17/	Technical Manual 3159 – 32 Channel Digital Output Card	3159 DO	-	5/22/2019
/D18/	Technical Manual 3147 32-Channel Digital Input Card	3147 DI	-	5/22/2019
/D19/	Technical Manual 3144/3146 16-Channel Analog Output Cards 3145 16-Channel Hart Enabled Analog Output Card	3144 & 3145 & 3146 AO	-	5/22/2019
/D20/	Technical manual 3132 AC DO card	3132 ACDO		5/22/2019
/D21/	Technical manual 3130 3131 and 3133 relay output card	3130 3131 & 3133 RO	-	5/22/2019
/D22/	Technical manual 3121 and 3122 AO card	3121 & 3122 AO	-	5/22/2019
/D23/	Technical manual 3115 and 3126 A/D IO card	3115 & 3126 AIDI	-	5/22/2019
/D24/	Technical manual 3109 and 3119 AI card	3109 & 3119 LLAI	-	5/22/2019
/D25/	Technical manual 3108 and 3118 AI card	3108 & 3118 HLAI	-	5/22/2019
/D26/	Technical manual thermocouple Input card	3107 TC	-	5/22/2019

Table 4: Documents provided for testing

Following test reports were issued by TÜV SÜD Rail GmbH or other accredited test laboratories. Documents listed here are related to all changes:

No.	Title	Document number / ID	Rev.	Date
Reviews, Emails, Minutes of Meetings				
[R1]	Review Protocol	ReviewProtocol_1_6 RTP	1.6	23.05.2019
[R2]	Review Protocol	Review Protocol HW FMEDA 3142 v1.1	1.1	16.05.2019
[R3]	Review Protocol	Review Protocol HW FMEDA 3144 3145 3146 v1.1	1.1	16.05.2019
[R4]	Review Protocol	Review Protocol HW FMEDA 3147 v1.3	1.3	15.03.2019
[R5]	Review Protocol	Review Protocol HW FMEDA 3148 3149 3150 3151 v1.1	1.1	20.05.2019
[R6]	Review Protocol	Review Protocol HW FMEDA 3159+TASACPWR+TASDCPW R v1.1	1.1	20.05.2019
[R7]	Review protocol	RTP_Manual_Review_1.0	1.0	13.05.2019
[R8]	FIT report	717517406_Test report Fault Insertion Tests	1.0	30.01.2019
Updated Certification Documentation				
[R9]	Annex of the report on the certificate	RP85295C-Annex-A1	1.7 1.8	2019.06.12 2019.06.17
[R10]	Technical Report of Modifications	This document		

Table 5: Test Reports

3.11.1 New system controller card 3200T

The modification is related to Subtask 1, new design based on existing 3000/06 and 3000/01 controller module.

Differences in 3000/06 & 3000/01 to the 3200T:

Former Node and Chassis Processors are combined into a single card. CPU, System Controller Hub, Memory and Ethernet remain the same as on 3000/06 Node processor. A USB Controller, Backplane Controller PLD and Backplane Transceivers are added to allow the card to communicate directly with the RTP backplane in place of the 3000/01 Chassis processor. Windowed Voltage monitors are added on all internal power rails. Disk-on-chip is replaced with SPI serial Flash.

No.	Title	Document number / ID	Rev.	Date
Design				
/D27/	Architectural Safety Requirements Specification	AE941-5011-021 Safety Requirements Specification	1	01/03/19
/D28/	Architectural Design Specification	AE941-5012-023 Architectural Design Specification	1	12/18/2018
/D29/	RTP3200 Engine Design Specification	AE855-5050-002 RTP3000 Design Spec	4	5/08/2019
/D30/	Engineering Design Specification for 3200T Processor	AE3200T	C	14/05/2019
/D31/	Engineering Design Specification for Backplane Controller PLD	AE860-5585-000	56	12/02/2019
/D32/	Appendix F2 IEC61508-2	APPENDIX_F2	-	-
/D33/	RTP3200 Series Safety System FMEA	AE941-5678-021 System FMEA	1	05/14/2019
/D34/	Qualification of Software Tools used in Developing Safety Related Products	AE835-9999-000 Qualification of Tools	7	4/9/2019
/D35/	Reference Manual NetArraysModule Form andLadder Form Objects	Netarraysobjects	-	3/19/19
/D36/	Technical Manual 3200T Processor	3200T Processor	-	5/22/2019
Testing				
/D37/	Fault Injection Testing for 3200T Processor	Fault_Injection_3200T	D	3/19/2019
/D38/	Simulation Results for Backplane Controller PLD	Simulation Results 860-5585-000	56	22/02/2019

Table 6: Documents provided for Updated system controller card 3200T

Result:

No.	Title	Document number / ID	Rev.	Date
/D39/	Review Protocol	ReviewProtocol_1_6	1.6	23.05.2019
The modification has been carried out and the verification and validation activities have shown that the changes did not raise any safety relevant objections.				

Table 7: Test Reports for Updated system controller card 3200T

3.11.2 New Power Supply Module (AC / DC Version)

The modification is related to Subtask 2

No.	Title	Document number / ID	Rev.	Date
Design				
/D40/	EDS - AC power supply	AETASACPWR_REV_A	A	10/6/15
/D41/	EDS - DC power supply	AETASDCPWR_REV_A	A	10/22/15
Testing				
/D42/	DVT - TAS Series AC Power Supply	DVT_TASACPWR_REV_A	A	8/17/15
/D43/	DVT - TAS Series DC Power Supply	DVT_TASDCPWR_REV_A	A	08/17/15

Table 8: Documents provided for Updated Power Supply Module (AC / DC Version)

Result:

No.	Title	Document number / ID	Rev.	Date
/D44/	Review Protocol	Review Protocol HW FMEDA 3159+TASACPWR+TASDCPW R v1.1	1.1	20.05.2019
The modification has been carried out and the verification and validation activities have shown that the changes did not raise any safety relevant objections.				

Table 9: Test Reports for Updated Power Supply Module (AC / DC Version)

3.11.3 New Chassis/Chassis Backplane

The modification is related to Subtask 3, new module 11SLOTBP

No.	Title	Document number / ID	Rev.	Date
Design				
/D45/	ESD - 11 SLOT BACKPLANE	AE11SLOTBP	A	4/28/16
Testing				
/D46/	DVT - 11 SLOT BACKPLANE	DVT_11SLOTBP	A	09/01/2016

Table 10: Documents provided for New Chassis/Chassis Backplane

Result:

No.	Title	Document number / ID	Rev.	Date
/D47/	Review Protocol	ReviewProtocol_1_6	1.6	23.05.2019
The modification has been carried out and the verification and validation activities have shown that the changes did not raise any safety relevant objections.				

Table 11: Test Reports for New Chassis/Chassis Backplane

3.11.4 New I/O Card (3142 - 8 Channel Pulse Input Card)

The modification is related to Subtask 4, new card 3142 is based on existing card 3000/01-029

Differences between 3000/01-029 and 3142:

Remove IDT microprocessor, memory and memory checker. Remove Ethernet ports. Remove Digital Inputs and Digital Outputs. Add RTP Backplane logic. PLDs replaced with MAX 10 PLDs. Added voltage monitors on DC-DC outputs.

No.	Title	Document number / ID	Rev.	Date
Design				
/D48/	EDS - 8 CHANNEL ISOLATED COUNTER CARD	AE3142_REV_A	A	2/22/2019
/D49/	EDS- 8 CHANNEL COUNTER CARD A PLD	AE860-5601-000_REV_6	6	6/5/2019
/D50/	EDS- 8 CHANNEL COUNTER CARD B PLD	AE860-5601-001_REV_6	6	6/4/2019
/D51/	FMEDA	FMEDA_3142_Counter_channel_rev_1	1	17.11.2018
/D52/	FMEDA common	FMEDA_3142_common_rev_4	4	25.03.2019
		FMEDA_3142_common_rev_5	5	09.05.2019
Testing				
/D53/	DVT - 8-CH Isolated Counter Card	DVT3142_REV_4	4	6/4/2019
/D54/	Simulation results PLD A	Simulation Results 860-5601-000_REV_6	6	6/5/2019

No.	Title	Document number / ID	Rev.	Date
/D55/	Simulation results PLD B	Simulation Results 860-5601-001_REV_6	6	6/5/2019

Table 12: Documents provided for New I/O Card (3142 - 8 Channel Pulse Input Card)

Result:

No.	Title	Document number / ID	Rev.	Date
/D56/	Review report	Review Protocol HW FMEDA 3142 v1.1	1.1	16.05.2019
The modification has been carried out and the verification and validation activities have shown that the changes did not raise any safety relevant objections.				

Table 13: Test Reports for New I/O Card (3142 - 8 Channel Pulse Input Card)

3.11.5 Updated I/O Card (3144, 3145, 3146 - 16 Channel Analog Output Card)

The modification is related to Subtask 5, new cards are based on existing card 3121 and 3122

Differences between 3121 and 3144:

Channels implemented with fewer ICs per channel. Loader PLD eliminated. PLDs replaced with MAX 10 PLDs.

Differences between 3121 and 3145:

Channels implemented with fewer ICs per channel. Loader PLD eliminated. PLDs replaced with MAX 10 PLDs. HART hardware added.

Differences between 3122 and 3146:

Channels implemented with fewer ICs per channel. Loader PLD eliminated. PLDs replaced with MAX 10 PLDs. HART hardware added.

No.	Title	Document number / ID	Rev.	Date
Design				
/D57/	ESD - 16-Channel Isolated Analog Output Card with HART (3144, 3145)	AE3144_3145_16AO_rev_A	A	12/4/18
/D58/	ESD - 16-Channel Isolated Analog Output Card with HART (3146)	AE3146_16AO_rev A	A	12/4/18

No.	Title	Document number / ID	Rev.	Date
/D59/	ESD - 16 Channel Analog Output Card A Control PLD	AE860-5605-000_REV_11	11	1/22/19
/D60/	ESD - 16 Channel Analog Output Card B Control PLD	AE860-5605-001_REV_11	11	1/23/19
/D61/	FMEDA 3144 channels	FMEDA_3144_channels_rev_2.xls	2	25.03.2019
/D62/	FMEDA 3144 common	FMEDA_3144_common_rev_2.xls	2	25.03.2019
/D63/	FMEDA 3145 HART common	FMEDA_3145_HART_common_rev_2.xls	2	25.03.2019
/D64/	FMEDA 3146 channels	FMEDA_3146_channels_rev_2.xls	2	25.02.2019
/D65/	FMEDA 3146 common	FMEDA_3146_common_rev_2.xls	2	25.03.2019
Testing				
/D66/	DVT – 3144 3145 16 Channel Isolated Analog Output Voltage Card	DVT3144_3145_rev_A	A	1/29/19
/D67/	DVT - 3146 16 Channel Isolated Analog Output Voltage Card	DVT3146_REV_A DVT3146_REV_B	A B	11/16/2018 5/10/19
/D68/	Simulation results 3144/3145/3146 16 CH AO Normal	Simulation Results 860-5605-000_REV_11.doc	11	1/23/19
/D69/	Simulation results 3144/3145/3146 16 CH AO Readback	Simulation Results 860-5605-001_REV_11.doc	11	1/23/19
/D70/	FIT - 3144/3145 16 Channel Isolated Analog Output Current Card	FI_3144_3145_REV_A	A	11/02/2018

Table 14: Documents provided for Updated I/O Card (3144, 3145, 3146 - 16 Channel Analog Output Card)

Result:

No.	Title	Document number / ID	Rev.	Date
/D71/	Review report	Review Protocol HW FMEDA 3144 3145 3146 v1.1		16.05.2019

No.	Title	Document number / ID	Rev.	Date
The modification has been carried out and the verification and validation activities have shown that the changes did not raise any safety relevant objections.				

Table 15: Test Reports for Updated I/O Card (3144, 3145, 3146 - 16 Channel Analog Output Card)

3.11.6 Updated I/O Card (3147 - 32 Channel Digital Input Card)

The modification is related to Subtask 6, new card 4147 is based on existing card 3002/02

Differences between 3002/02 and 3147:

Changed from 16 CH to 32 CH. Diagnostics re-designed to use fewer opto-couplers. Upgraded from single PLD to Dual MAX 10 PLDs.

No.	Title	Document number / ID	Rev.	Date
Design				
/D72/	32 CHANNEL DIGITAL INPUT CARD	AE3147_REV_A AE3147_REV_B	A B	10/10/18 22/02/2019
/D73/	32 CHANNEL DC DIGITAL INPUT CARD NORMAL PLD	AE860-5621-000_REV_6 AE860-5621-000_REV_8	6 8	10.10.18 21.02.19
/D74/	32 CHANNEL DC DIGITAL INPUT CARD INVERSE PLD	AE860-5621-001_REV_6 AE860-5621-001_REV_8	6 8	10.10.18 23.02.2018
/D75/	32 CHANNEL AC DIGITAL INPUT CARD NORMAL PLD	AE860-5621-002_REV_3 AE860-5621-002_REV_4	3 4	10.04.18 21.02.19
/D76/	32 CHANNEL AC DIGITAL INPUT CARD INVERSE PLD	AE860-5621-003_REV_3 AE860-5621-003_REV_4	3 4	10.03.18 21.02.19
/D77/	FMEDA	FMEDA_3147_channel_rev_4_24VDC FMEDA_3147_channel_rev_5_24VDC FMEDA_3147_channel_rev_6_24VDC	4 5 6	26.07.2018 22.02.2019 25.03.2019
/D78/	FMEDA	FMEDA_3147_channel_rev_4_AC FMEDA_3147_channel_rev_5_AC FMEDA_3147_channel_rev_6_AC	4 5 6	18.10.2018 25.03.2019 10.05.2019

No.	Title	Document number / ID	Rev.	Date
/D79/	FMEDA	FMEDA_3147_common_rev_4	4	27.07.2018
		FMEDA_3147_common_rev_5	5	27.02.2019
		FMEDA_3147_common_rev_6	6	25.03.2019
/D80/	FMEDA	FMEDA_3147-4_common_rev_4	4	27.07.2018
		FMEDA_3147-4_common_rev_5	5	27.02.2019
		FMEDA_3147-4_common_rev_6	6	25.03.2019
Testing				
/D81/	DESIGN VERIFICATION TESTS And FAULT INJECTION TESTING	DVT3147_B	B	18.02.2019

Table 16: Documents provided for Updated I/O Card (3147 - 32 Channel Digital Input Card)

Result:

No.	Title	Document number / ID	Rev.	Date
/D82/	Review report	Review Protocol HW FMEDA 3147 v1.3	1.3	15.03.2019
The modification has been carried out and the verification and validation activities have shown that the changes did not raise any safety relevant objections.				

Table 17: Test Reports for Updated I/O Card (3147 - 32 Channel Digital Input Card)

3.11.7 Updated I/O Card – (3148, 3149, 3150, 3151, 3152 - 32 Ch Analog Input, 3153 - 32 Ch Digital Input)

The modification is related to Subtask 7, new cards 3148, 3149, 3151 are based on existing cards 3115.

Differences between 3115 and 3148:

I-to-V resistor moved from termination module to this card. Control for analog switches changed from individual opto-couplers to an isolated serial interface. Loader PLD eliminated. Two DC-DC converts replaced with one DC-DC converter. PLDs replaced with MAX 10 PLDs. HART hardware added.

Differences between 3115 and 3149:

Control for analog switches changed from individual opto-couplers to an isolated serial interface.

Loader PLD eliminated. Two DC-DC converts replaced with one DC-DC converter. PLDs replaced with MAX 10 PLDs. HART hardware added.

Differences between 3115 and 3150:

I-to-V resistor moved from termination module to this card. Control for analog switches changed from individual opto-couplers to an isolated serial interface. Loader PLD eliminated. Two DC-DC converts replaced with one DC-DC converter. PLDs replaced with MAX 10 PLDs.

Differences between 3115 and 3151:

I-to-V resistor moved from termination module to this card. Control for analog switches changed from individual opto-couplers to an isolated serial interface. Loader PLD eliminated. Two DC-DC converts replaced with one DC-DC converter. PLDs replaced with MAX 10 PLDs.

Differences between 3151 and 3152, 3153:

There are no physical changes being made to the cards or documentation. The current submitted documentation included all the testing and verification for each input type (3151, 3152 and 3153). The additional model numbers are to make it easier for the customers.

No.	Title	Document number / ID	Rev.	Date
Design				
/D83/	ESD - 32-CH ANALOG INPUT CARD (Current)	AE3148_3149_3150_3151_RE V_A AE3148_3149_3150_3151_3152_5153_REV_B	A B	2/22/19 5/14/19
/D84/	ESD - 32 Channel Analog Input Card A Control PLD	AE860-5622-000_REV_12 AE860-5622-000_REV_12.1	12 12.1	2/6/19 5/11/19
/D85/	ESD - 32 Channel Analog Input Card B Control PLD	AE860-5622-001_REV_12 AE860-5622-001_REV_12.1	12 12.1	2/6/19 5/11/19
/D86/	FMEDA 3148 channels	FMEDA_3148_channels_rev_3 FMEDA_3148_channels_rev_4	3 4	25.03.2019 13.05.2019
/D87/	FMEDA 3148 common	FMEDA_3148_common_rev_3	3	25.03.2019
/D88/	FMEDA 3149 channels	FMEDA_3149_channels_rev_3	3	25.03.2019
/D89/	FMEDA 3150 common	FMEDA_3150_common_rev_3	3	23.03.2019
Testing				
/D90/	DVT – 32 Channel Isolated Analog Current Input Card With HART	DVT3148_rev_2 DVT3148_rev_3	2 3	1/19/19 5/11/19

No.	Title	Document number / ID	Rev.	Date
/D91/	Simulation results	Simulation Results 860-5622-000_REV_12	12	2/1/19
/D92/	Simulation results	Simulation Results 860-5622-001_REV_12	12	2/1/19

Table 18: Documents provided for Updated I/O Card – (3148, 3149, 3150, 3151 - 32 Ch Analog Input)

Result:

No.	Title	Document number / ID	Rev.	Date
/D93/	Review report	Review Protocol HW FMEDA 3148 3149 3150 3151 v1.1	1.1	20.05.2019
The modification has been carried out and the verification and validation activities have shown that the changes did not raise any safety relevant objections.				

Table 19: Test Reports for Updated I/O Card – (3148, 3149, 3150, 3151 - 32 Ch Analog Input)

3.11.8 Updated I/O Card (3159 - 32 Ch Digital Output)

The modification is related to Subtask 8, new card 3159 is based on existing card 3139.

Differences between 3139 and 3159:

Expanded from 24 Channels to 32 Channels retaining 8 safety switches (one for every 4 channels). Channels implemented with fewer ICs per channel. Control for digital outputs changed from individual opto-couplers to an isolated serial interface. Loader PLD eliminated. PLDs replaced with MAX 10 PLDs.

No.	Title	Document number / ID	Rev.	Date
Design				
/D94/	ESD - 32 CHANNEL FAULT DETECTING DIGITAL OUTPUT CARD	AE3159_DO_REV_B	B	5/14/2019
/D95/	ESD - 32 CHANNEL DIGITAL OUTPUT CARD PLD A	AE860-5624-000_REV_8.1	8.1	5/11/2019
/D96/	ESD - 32 CHANNEL DIGITAL OUTPUT CARD PLD B	AE860-5624-001_REV_8.1	8.1	5/11/2019
/D97/	FMEDA 3159 channels	FMEDA_3159_channels_rev_2	2	25.01.2019
/D98/	FMEDA 3159 common	FMEDA_3159_common_rev_2	2	22.02.2019

No.	Title	Document number / ID	Rev.	Date
Testing				
/D99/	DVT - 32-CH FAULT DETECTING DIGITAL OUTPUT CARD	DVT_3159_rev_B	B	5/11/2019
/D100/	Simulation results	Simulation Results 860-5624-000_REV_8	8	11/02/2018
/D101/	Simulation results	Simulation Results 860-5624-001_REV_8	8	11/02/2018

Table 20: Documents provided for Updated I/O Card (3159 - 32 Ch Digital Output)

Result:


No.	Title	Document number / ID	Rev.	Date
/D102/	Review report	Review Protocol HW FMEDA 3159+TASACPWR+TASDCPW R v1.1	1.1	20.05.2019
The modification has been carried out and the verification and validation activities have shown that the changes did not raise any safety relevant objections.				

Table 21: Test Reports for Updated I/O Card (3159 - 32 Ch Digital Output)


4 Approval of the Technical Certifier

Decision:	Yes	No	Remark
Do the documented changes have an impact to the product safety concept?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Is the compliance of the product to the standards mentioned in the certification documentation still given?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Does the modification imply an update of the related certification documentation (e. g. annex, report to the certificate and certificate)?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Annex update

Table 22: Approval of the Technical Certifier


 Digital
 unterschrieben
 von Peter Weiß
 Datum:
 2019.06.17
 11:20:18 +02'00'

Technical Certifier


 Digital
 unterschrieben von
 Peerasan
 Supavatanakul
 Datum: 2019.06.17
 13:30:53 +02'00'

Project Manager



Choose certainty.
Add value.

Annex of the Report on the Certificate

Z10 14 02 60643 007

Safety-Related Programmable System

Technical report

RTP3000 TAS

Manufacturer:
RTP Corporation
2832 Center Port Circle
Pompano Beach
FL 33064
USA

Test report no.: RP85295C
Revision 1.8 dated 2019-06-17

Testing Body:
TÜV SÜD Rail GmbH
Ridlerstraße 57
D-80339 München



Revision Log

Version	Name	Date	Changes/History
1.0	K. Leupold / P. Weiß	2013-12-17	Initial
1.1	J. Dong	2014-03-31	Certificate updated as Z10 14 02 60643 007 Modification RP85651T rev. 1.0
1.2	P. Weiß	2015-06-22	Module versions updated New modules included Modification RP85294T rev. 1.0
1.3	P. Weiß	2015-06-23	Formal updates
1.4	P. Weiß	2017-02-13	Module versions updated Modification RP90267T rev. 1.0
1.5	J. Luther	2018-04-26	Module versions updated Modification RP9246T rev. 1.0
1.6	J. Luther	2018-06-04	Formal updates Modification RP9246T rev. 1.1
1.7	A. Valente	2019-06-12	Modification report RP93979T_1.0
1.8	P. Weiß	2019-06-17	Modification report RP93979T_1.1; including formal updates



Safety-Certified and Interference-Free Components

1 Hardware Components

1.1 Safety-related hardware components

The following system components are certified 'safety-related'. This allows the components to be used to process safety critical signals and functions:

Model	Component	SIL Single	SIL Redundant	HW Rev	FW Rev	Module Description
3000/02	Node Processor	2	3	C	A5.02 A5.10 A5.22	Processor which is suitable for safety-related applications by using a fail-safe-application program.
3000/06	Atom Processor	2	3	B, F, H	A5.10 A5.22 A9.2.0.33	Processor which is suitable for safety-related applications by using a fail-safe-application program.
3000/01	Chassis Processor	3	3	H, J	A5.02 A5.10 A5.22 A9.2.0.33	Processor responsible for the I/O communication.
3200T	Node/Chassis Processor	2	3	A	A9.2.0.38	Processor that runs the users application and handles the I/O communication.
3000/01 M	Micro Processor	2	N/A	J	A5.01 A5.03	Processor that handles the I/O communication, as well as running user applications.
I/O Modules						
3000/01 -029	8-Ch. Counter	2	2	B	A5.00 A5.04 A5.06	8 Channel Distributed Intelligent Counter Card for Magnetic Pickup Sensors
3107	8-Ch. Thermocouple	2	3	B, C, E, G	N/A	8 Channel Thermocouple



Model	Component	SIL Single	SIL Redundant	HW Rev	FW Rev	Module Description
3108	8-Ch. High Level AI	2	3	C, D, F, G, J	N/A	8 Channel High Level AI
3109	8-Ch. Low Level AI	2	3	C, D, F, H	N/A	8 Channel Low Level AI
3115	32-Ch. AI / DI	2	3	B, C, F, G, H	N/A	32 Channel AI / DI
3121	16-Ch. AO	3	3	B, C, F, G, H	N/A	16 Channel AO, -20 to +20, 0 to 20, or 4 to 20 mA
3122	16-Ch. AO	3	3	B, C, F, G, H	N/A	16 Channel AO, -10 to +10 or 0 to 10 Volts
3126	32-Ch. AI / DI	3	3	B, C, F, G, H	N/A	32 Channel AI / DI - High Availability
3128	16-Ch. DO	3	3	A, B, D	N/A	16 Channel DO
3129	24-Ch. DO	2	2	A, B, D	N/A	24 Channel DO
3130	12- Ch. Relay Output	3	3	A, B, D, E	N/A	12 Channel 24V DC Relay Output
3131	12- Ch. Relay Output - 120 VAC	3	3	A, D, E	N/A	12 Channel 120V AC Relay Output
3133	12- Ch. Relay Output - 240 VAC	3	3	A, C, D	N/A	12 Channel 240V AC Relay Output



Model	Component	SIL Single	SIL Redundant	HW Rev	FW Rev	Module Description
3132	16-Ch. AC DO	2	3	A, B, D, E	N/A	16 Channel AC DO
3138	32-Ch DO	2	2	C, D	N/A	32 Channel DO
3139	24-Ch DO	3	3	D, E	N/A	24 Channel DO
3140	18-Ch DO	3	3	D, E	N/A	18 Channel DO
3142-1	8-Ch Pulse Input	2	3	B	N/A	8 Channel Pulse Input, 3V
3142-3	8-Ch Pulse Input	2	3	B	N/A	8 Channel Pulse Input, 24V
3144	16-Ch AO, Current	3	3	A	N/A	16 Channel AO, 0 to 20, or 4 to 20 mA
3145	16-Ch AO, Current w/ HART	3	3	A	N/A	16 Channel AO, 4 to 20 mA, HART Enabled
3146	16-Ch AO, Voltage	3	3	A	N/A	16 Channel AO, -10 to +10 or 0 to 10 Volts
3147-1	32-Ch DI, 24 VDC	3	3	A	N/A	32 Channel Digital Input, 24 VDC
3147-2	32-Ch DI, 48 VDC	3	3	A	N/A	32 Channel Digital Input, 48 VDC
3147-3	32-Ch DI, 120 VDC	3	3	A	N/A	32 Channel Digital Input, 120 VDC
3147-4	32-Ch DI, 120 VAC	3	3	A	N/A	32 Channel Digital Input, 120 VAC
3147-5	32-Ch DI, 240 VAC	3	3	A	N/A	32 Channel Digital Input, 240 VAC



Model	Component	SIL Single	SIL Redundant	HW Rev	FW Rev	Module Description
3148	32-Ch Analog Input, current w/ HART	3	3	A	N/A	32 Channel Analog Input w/ HART, Single Configuration, 4 - 20 mA
3149	32-Ch AI, current w/ HART	3	3	A	N/A	32 Channel Analog Input w/ HART, Redundant Configuration, 4 - 20 mA
3150	32-Ch AI, current	3	3	A	N/A	32 Channel Analog Input, Single Configuration, +/- 20 mA, 4 - 20 mA
3151	32-Ch AI, current	3	3	A	N/A	32 Channel Analog Input, Redundant Configuration, +/- 20 mA, 4 - 20 mA
3152	32-Ch AI, voltage	3	3	A	N/A	32 Channel Analog Input Card, +/- 10 V
3153	32-Ch Supervised DI	3	3	A	N/A	32 Channel Supervised Digital Input
3159	32-Ch DO, 24 VDC	3	3	A	N/A	32 Channel Digital Output, 24 VDC

1.2 Safety-relevant hardware components

The following system components are certified 'safety-relevant', i.e. they are supporting hardware to be attached to the safety system:

Model	Version	Module Description
		Single Termination Modules
3099/11-100	B	8 Channel Current AI
3099/12-100	B	12 Channel Sourcing (Breaks the Positive) Relay Output, 24 VDC
3099/12-101	B	12 Channel Sinking (Breaks Ground) Relay Output, 24 VDC
3099/12-102	A	12 Channel Sourcing (Breaks the Positive) Relay Output, 24 VDC Common Feed
3099/13-100	B	12 Channel Sourcing (Breaks the Positive) Relay Output, 120 VAC
3099/13-101	B	12 Channel Sinking (Breaks Ground) Relay Output, 120 VAC
3099/13-102	A	12 Channel Sourcing (Breaks the Positive) Relay Output, 120 VAC Common Feed



Model	Version	Module Description
3099/17-100	B	16 Channel AC DO
3099/21-101	F	32 Channel Supervised DI, 24 VDC
3099/21-102	E	32 Channel Voltage AI
3099/21-103	H	32 Channel Sinking (Close to Positive) DI, 24 VDC
3099/21-104	C	32 Channel Sinking (Close to Positive) DI, 48 VDC
3099/21-105	B	32 Channel Sinking (Close to Positive) DI, 120 VAC
3099/21-106	B	32 Channel Sinking (Close to Positive) DI, 240 VAC
3099/21-107	B	32 Channel Current AI, supplies power from 100 mA resettable fuses
3099/21-108	A	32 Channel Sinking (Close to Positive) DI, 120 VDC
3099/21-109	B	32 Channel Channel-to-Channel Isolated DI, 120 VAC
3099/21-113	A	32 Channel Sourcing (Close to Ground) DI, 24 VDC
3099/21-114	A	32 Channel Sourcing (Close to Ground) DI, 48 VDC
3099/21-115	A	32 Channel Sourcing (Close to Ground) DI, 120 VAC
3099/21-116	A	32 Channel Sourcing (Close to Ground) DI, 240 VAC
3099/21-118	A	32 Channel Sourcing (Close to Ground) DI, 120 VDC
3099/21-207	A	32 Channel Current AI, supplies power from 300 mA resettable fuses
3099/22-100	B	16 Channel AO
3099/23-100	D	Thermocouple
3099/31-100	A	8 Channel Voltage AI
3099/35-001	C	24 Channel DC DO
3099/36-001	C	16 Channel DC DO
3099/37-100	A	8 Channel Counter
3099/48-001	A	32 Channel DO
3099/52-001	A	24 Channel DO
3099/53-001	A	18 Channel DO
		Dual Termination Modules
3099/18	A	16 Channel AC DO
3099/35-000	C	24 Channel DC DO
3099/48-000	A	32 Channel DO
		Triple Termination Modules
3099/03-000	D	Thermocouple
3099/11-000	B	8 Channel Current AI
3099/12-000	B	12 Channel Sourcing (Breaks the Positive) Relay Output, 24 VDC
3099/12-001	B	12 Channel Sinking (Breaks Ground) Relay Output, 24 VDC
3099/12-002	A	12 Channel Sourcing (Breaks the Positive) Relay Output, 24 VDC Common Feed
3099/13-000	B	12 Channel Sourcing (Breaks the Positive) Relay Output, 120 VAC
3099/13-001	B	12 Channel Sinking (Breaks Ground) Relay Output, 120 VAC



Model	Version	Module Description
3099/13-002	A	12 Channel Sourcing (Breaks the Positive) Relay Output, 120 VAC Common Feed
3099/21-001	F	32 Channel Supervised DI, 24 VDC
3099/21-002	E	32 Channel Voltage AI
3099/21-003	H	32 Channel Sinking (Close to Positive) DI, 24 VDC
3099/21-004	C	32 Channel Sinking (Close to Positive) DI, 48 VDC
3099/21-005	B	32 Channel Sinking (Close to Positive) DI, 120 VAC
3099/21-006	B	32 Channel Sinking (Close to Positive) DI, 240 VAC
3099/21-007	B	32 Channel Current AI, supplies power from 100 mA resettable fuses
3099/21-008	A	32 Channel Sinking (Close to Positive) DI, 120 VDC
3099/21-009	A	32 Channel Channel-to-Channel Isolated DI, 120 VAC
3099/21-013	B	32 Channel Sourcing (Close to Ground) DI, 24 VDC
3099/21-014	A	32 Channel Sourcing (Close to Ground) DI, 48 VDC
3099/21-015	A	32 Channel Sourcing (Close to Ground) DI, 120 VAC
3099/21-016	A	32 Channel Sourcing (Close to Ground) DI, 240 VAC
3099/21-018	A	32 Channel Sourcing (Close to Ground) DI, 120 VDC
3099/21-307	A	32 Channel Current AI, supplies power from 300 mA resettable fuses
3099/22-000	A	16 Channel isolated AO
3099/24-100	B	16 Channel AC DO
3099/31-000	A	8 Channel Voltage AI
3099/36-000	C	16 Channel DC DO
3099/37-000	A	8 Channel Counter
3099/52-000	A	24 Channel DO
3099/53-000	A	18 Channel DO
		Other Modules
3099/10-000	A	Filler Card
		Power Supplies
3000DCPWR	A	DC Power Supply
3000ACPWR	A, C, D	AC Power Supply
TASDCPWR	C	DC Power Supply
TASACPWR	C	AC Power Supply















For details on architectural, configuration and implementation requirements, please refer to the relevant manuals.

2 Safety-Relevant Software Components



















2.1 Application Configuration and Programming Software






NetArrays Developer Studio	Version 9.0.0.XX ¹ 9.2.X.XX ¹
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

2.2 SIL-certified library function modules:

























Flow Chart Form Objects		
Symbol	Symbolic Name	Function
	Text Box	Adds descriptive text to Flow Chart Form
	Main	Defines the starting point on a Main Flow Chart Form
	Start	Defines the starting point on a Flow Chart Form
	Exit	Defines the ending point on a Flow Chart Form
	Stop Scan	Stops I/O scanning
	Scan	Resumes I/O scanning
	Sequence	Defines a Flow Chart Form
	Module	Defines a Module Form
	Ladder	Defines a Ladder Logic Form
	State	Defines a State Logic Flow Chart
	State Sequence	Defines a Flow Chart Form that is part of a State Logic Flow Chart
	State Module	Defines a Module Form that is part of a State Logic Flow Chart
	State Ladder	Defines a Ladder Logic Form that is part of a State Logic Flow Chart
	State Exit	Defines the ending Module Form on a State Logic Flow Chart

























¹ The version number could include an extension, e.g. 9.0.0.5 or 9.2.0.40 whereas the "X" is related to the version management of the non-safety related parts of the NetArrays Developer Studio and therefore not included into this document



























Module Form Objects		
Symbol	Symbolic Name	Function
	Text Box	Adds descriptive text to Module Form
	Float Constant	Defines a floating-point constant
	Float Variable	Defines a floating-point variable
	Float Variable Array	Defines an array of floating-point variables
	Bool Greater Than	Compares two floating-point values
	Bool Less Than	Compares two floating-point values
	Bool Equal	Compares two floating-point values
	Bool Greater or Equal	Compares two floating-point values
	Bool Less or Equal	Compares two floating-point values
	Bool Not Equal	Compares two floating-point values
	Float Compare	Compares floating-point values with deadband
	Float Invert	Changes the sign of a floating-point value
	Float Absolute Value	Finds the absolute value of a floating-point value
	Float Average	Computes average of three floating-point values
	Float Add	Adds two floating-point values
	Float Subtract	Subtracts two floating-point values
	Float Multiply	Multiplies two floating-point values
	Float Divide	Divides two floating-point values
	Float Max	Finds maximum of three floating-point values
	Float Min	Finds minimum of three floating-point values
	Float Limit	Limits the range of a floating-point value
	Float Ratio	Applies scale and offset to a floating-point value
	Float Gate	Selects one of two floating-point values
	Float Waveform Generator	Generates a user-selected real-time waveform
	Float Delay	Delays a floating-point value by one scan


Module Form Objects		
Symbol	Symbolic Name	Function
	Float FIFO	Stores floating-point values in a FIFO buffer
	Float Filter	Applies filter function to a floating-point value
	Float Lead/Lag Filter	Applies filter function to a floating-point value
	Float Integral	Integrates floating point value over a time period
	Float Sine	Computes the sine of a floating-point angle
	Float Cosine	Computes the cosine of a floating-point angle
	Float Tangent	Computes the tangent of a floating-point angle
	Float Arc Tangent	Computes the angle of a floating-point tangent
	Float Exponential	Computes exponential of a floating-point value
	Float Power	Raises a floating-point value to a given power
	Float Log e	Computes natural log of a floating-point value
	Float Log 10	Computes base 10 log of a floating-point value
	Float Square Root	Computes square root of a floating-point value
	Float Alarm	Monitors floating-point value for alarm conditions
	Float TPC	Timing Proportioning Controller
	Float RL-PID	Rate-limited PID Controller
	Float RL-PID2	Dual/Cascade Rate-limited PID Controller
	Float Multiple Add	Adds up to ten floating-point values
	Float Multiple Subtract	Subtracts up nine floating-point values from a floating point value
	Float Multiple Multiply	Multiplies up to ten floating-point values
	Float Totalizer	Integrates floating point value in real-time with high-precision
	Partial Stroke Test	Used together with an analog output card and the HART communications card to perform partial stroke testing of valves
	Int Constant	Defines an integer constant
	Int Variable	Defines an integer variable
















Module Form Objects		
Symbol	Symbolic Name	Function
	Int Variable Array	Defines an array of integer variables
	Bool Greater Than	Compares two integer values
	Bool Less Than	Compares two integer values
	Bool Equal	Compares two integer values
	Bool Greater or Equal	Compares two integer values
	Bool Less or Equal	Compares two integer values
	Bool Not Equal	Compares two integer values
	Bool Compare	Compares integer values with deadband
	Int Invert	Changes the sign of an integer value
	Int Absolute Value	Finds the absolute value of an integer value
	Int Average	Computes average of three integer values
	Int Add	Adds two integer values
	Int Subtract	Subtracts two integer values
	Int Multiply	Multiplies two integer values
	Int Divide	Divides two integer values
	Int Max	Finds maximum of three integer values
	Int Min	Finds minimum of three integer values
	Int Limit	Limits the range of an integer value
	Int Ratio	Applies scale and offset to a integer value
	Int Gate	Selects one of two integer values
	Int Waveform Generator	Generates a user-selected real-time waveform
	Int Delay	Delays an integer value by one scan
	Int FIFO	Stores integer values in a FIFO buffer
	Int Filter	Applies filter function to an integer value
	Int Time	Generates clock/calendar codes

Module Form Objects		
Symbol	Symbolic Name	Function
	Bool Schedule	Activates output based on a scheduled time
	Int Modulo	Calculates the remainder of an integer divide
	Int Bit Variable	Accesses one bit of an integer variable
	Int Bit Counter Accumulator	Accesses one bit of a counter accumulator
	Int Bit Timer Accumulator	Accesses one bit of a timer accumulator
	Int And	Computes AND of three integer values
	Int Nand	Computes NAND of three integer values
	Int Or	Computes OR of three integer values
	Int Xor	Computes exclusive OR of two integer values
	Int Complement	Complements an integer value
	Int Shift	Performs shift or rotate operations on integer values
	Int Multiple Add	Adds up to ten integer values
	Int Multiple Subtract	Subtracts up nine integer values from an integer value
	Int Multiple Multiply	Multiplies up to ten integer values
	Bool Constant	Defines a Boolean constant
	Bool Variable	Defines a Boolean variable
	Bool Variable NO	Defines a Boolean normally-open variable
	Bool Variable NC	Defines a Boolean normally-closed variable
	Bool Variable Reset	Defines a Boolean reset variable
	Bool Variable Set	Defines a Boolean set variable
	Bool Toggle Flip Flop	Implements a toggle flip-flop
	Bool Latching Flip Flop	Implements a latching flip-flop
	Bool HOHC	Sets minimum on time/off time of Boolean value
	Bool Pulse	Produces a Boolean pulse


Module Form Objects		
Symbol	Symbolic Name	Function
	Bool And	Computes the AND of three bit values
	Bool Nand	Computes the NAND of three bit values
	Bool Or	Computes the OR of three bit values
	Bool Xor	Computes the exclusive OR of two bit values
	Bool Inverter	Inverts a bit value
	Bool Multiple Or	Computes the OR of up to ten bit values
	Bool Multiple And	Computes the AND of up to ten bit values
	Bool Multiple Nand	Computes the NAND of up to ten bit values
	Bool Gate	Selects one of two bit values
	Bool Counter	Counts the number of input pulses
	Bool Counter NO	Defines a normally-open Counter switch
	Bool Counter NC	Defines a normally-closed Counter switch
	Int Counter Acc	Defines an integer Counter accumulator
	Int Counter Acc Array	Defines an array of Counter accumulators
	Int Counter Acc Reset	Clears a Bool Counter
	Bool Timer	Measures a given time period
	Bool Timer NO	Defines a normally-open Timer switch
	Bool Timer NC	Defines a normally-closed Timer switch
	Int Timer Acc	Defines an integer Timer accumulator
	Int Timer Acc Array	Defines an array of Timer accumulators
	Int Timer Acc Reset	Clears a Bool Timer
	Bool Up/Down Counter	Generic up or down counter
	Float Int to Float	Converts an integer to a floating-point value
	Bool Int to Bool	Converts an integer to a bit value

Module Form Objects		
Symbol	Symbolic Name	Function
	BCD Int to BCD	Converts an integer to a binary coded decimal
	Int BCD to Int	Converts a binary coded decimal to an integer
	Int Bool to Int	Converts a bit value to an integer value
	Int Float to Int	Converts a floating-point to an integer value
	Int Decode/Encode	Decodes an integer value into sixteen bit values or encodes sixteen bit values into one integer value
	Bool Escape	Provides an escape from a MForm and FForm
	FForm	Performs a jump to a function form (FForm)
	Dual FForm	Performs a jump to a Dual Function Form (FForm)
	FForm In	Provides inputs to an FForm
	FForm Out	Provides an output from an FForm
	CForm	Defines a C/C++ User Defined Function
	STForm	Defines a Structured Text User Defined Function
	Legacy FForm	Performs a jump to a Legacy Function Form (FForm)
	Index Table	Accesses a table of variables by index
	Search Table	Accesses a table of variables by matching value
	Fill Table	Writes to a table of variables
	Move Table	Copies and converts a table to another table
	Function Table	Generates output based on selected algorithm
	Disable Outputs	Disable the output cards being updated from the user logic
	Save Program	Save the current running program state on the flash storage
	Clear Ronly Forces	Command all forced read-only variables to be unforced.
	Node Info	Reports Node Processor Diagnostic Information
	Chassis Info	Reports Chassis Processor Diagnostic Information
	Int ROnly Forces	Reports the number of read-only variables that are being forced
	Int RW Forces	Reports the number of read/write variables that are being forced
	Node Shutdown	Program the Node Processors to be conditionally turned off or rebooted and Power-On-Self-Tested

Module Form Objects		
Symbol	Symbolic Name	Function
	Online Update	Produces a Boolean indication if the user application is running from a cold startup of the system or from a download (with online update) operation.

Ladder Form Objects		
Symbol	Symbolic Name	Function
	Text Box	Adds descriptive text to Ladder Logic Form
	Examine If Closed	Defines a normally open switch
	Examine If Open	Defines a normally closed switch
	Coil	Determines the value of a Boolean variable
	Latch Coil	Determines the value of a Boolean variable
	Unlatch Coil	Determines the value of a Boolean variable
	Reset Counter	Resets a Counter and Counter Accumulator
	Reset Timer	Resets a Timer and Timer Accumulator
	One Shot Rising Contact	Generates a single pulse on input transition
	One Shot Falling Contact	Generates a single pulse on input transition
	Count Up Counter	Counts input pulses
	Count Down Counter	Counts input pulses
	Timer-On Delay	Counts time ticks when input is true
	Timer-Off Delay	Counts time ticks when input is false
	Retentive Timer	Counts time ticks when input is true

Munich, 2019-06-17


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