Parts List

Base Units

Part No.	Part Description
T9100	Processor base unit
T9300	I/O base unit (3 way)

Modules

Part No.	Part Description
T9110	Processor module
T9401	Digital input module, 24 Vdc, 8 channel, isolated
T9402	Digital input module, 24 Vdc, 16 channel, isolated
T9451	Digital output module, 24 Vdc, 8 channel, isolated, commoned
T9431	Analogue input module, 8 channel, isolated
T9432	Analogue input module, 16 channel, isolated
T9481	Analogue output module, 3 channel, isolated
T9482	Analogue output module, 8 channel, isolated

Special Application Modules

Part No.	Part Description
T9441	Frequency Input Module (Product not yet released. Contact Sales for more information)

Termination Assemblies

Part No.	Part Description
T9801	Digital input TA, 16 channel, simplex, commoned
T9802	Digital input TA, 16 channel, dual
T9803	Digital input TA, 16 channel, TMR
T9831	Analogue input TA, 16 channel, simplex, commoned
T9832	Analogue input TA, 16 channel, dual
T9833	Analogue input TA, 16 channel, TMR
T9851	Digital output TA, 24Vdc, 8 channel, simplex, commoned
T9852	Digital output TA, 24Vdc, 8 channel, dual
T9881	Analogue output TA, 8 channel, simplex commoned

Part No.	Part Description
T9882	Analogue output TA, 8 channel, dual
T9844	Frequency Input Module TA, Simplex, Active (not yet released)
T9845	Frequency Input Module TA, Dual, Active (not yet released)
T9846	Frequency Input Module TA, TMR, Active (not yet released)
T9847	Frequency Input Module TA, Simplex, Passive (not yet released)
T9848	Frequency Input Module TA, Dual, Passive (not yet released)
T9849	Frequency Input Module TA, TMR, Passive (not yet released)

Expansion Cable Assembly

Expansion cable assembly, comprising expansion cable and two adapters

Part No.	Part Description
T9310-02	Backplane expansion cable, 2 meter

Blanking Covers

Part No.	Part Description
T9191	Blanking cover (tall) for I/O positions with no TA fitted
T9193	Blanking cover (short) for I/O positions with TA or a Processor

Spares and Tools

Part No.	Part Description
T9901	Replacement input fuse 50 mA for T9801/2/3 and T9831/2/3, pack of 20 [1]
T9902	Replacement output fuse 10A for T9851/2, pack of 20 [2]
T9903	Replacement coding pegs (pack of 20)
T9904	Replacement backplane clips (pack of 20)
T9905	Replacement processor 3 V lithium cell, pack of 20 [3]
T9906	Replacement program enable key
T9907	Installation tool kit
T9908	Fuse Extractor Tool

(1)   T9901: No 396/TE5 50 mA time lag fuse; UL 248-14, 125 V, Leadfree; manufactured by Littelfuse.

(2)   T9902: SMF Omni-Block, Surface Mount Fuse Block 154 010, with a 10 A, 125 V Fast Acting Fuse, Littelfuse.

(3)   T9905: Polycarbon monofluoride Lithium Coin Battery, BR2032, 20 mm dia; Nominal voltage 3 V; Nominal capacity (mAh) 190; Continuous standard load (mA) 0.03; Operating temperature -30 °C to +80 °C, supplied by Panasonic.

Software

Part No.	Part Description
T9082U	IEC 61131 Workbench, USB key, single user, single controller
T9082D	IEC 61131 Workbench, hard disk key, single user, single controller
T9083U	IEC 61131 Workbench, USB key, multiple controllers
T9083D	IEC 61131 Workbench, hard disk key, multiple controllers
T9084U	IEC 61131 Workbench, 5 user USB key, multiple controllers

Part No.	Part Description
T9087	IEC 61131 Workbench 2
T9090	AADvance®-Trusted® SIS Workstation software AADvance® license
T9030	OPC portal server
T9033	AADvance DTM (for use with HART Pass-Through feature)

Demonstration Unit

Part No.	Part Description
T9141	AADvance Demonstration Unit (Including HMI)

Miscellaneous Items

Part No.	Part Description

Notes:

History of Changes

This appendix contains the new or updated information for each revision of this publication. These lists include substantive updates only and are not intended to reflect all changes. Translated versions are not always available for each revision.

ICSTT-RM448M-EN-P, February 2021

Change
Updated for AADvance® system release 1.40 TÜV Rheinland certification.
Applied latest publication template.
Changed *workstation* to *computer*.
Added AADvance®-Trusted® SIS Workstation software information where applicable.
Changed *Workbench* to *software* where applicable.
Changed *Workbench* to *AADvance Workbench software* where applicable.
Added reference to AADvance-Trusted SIS Workstation Software User Guide, publication ICSTT-UM002.
Updated AADvance system release and software information in the AADvance Release section.
Added IMPORTANT and ATTENTION tables with information on supported languages in the The AADvance Safety Controller section.
Removed information indicating that AADvance processor modules are designed to meet the requirements for SIL 2 in a simplex configuration in Safety Features section.
Removed footnote on Minimum cycle time overhead in the Scan Times section.
Changed The AADvance Workbench and Software Development Environment section to The AADvance Software Development Environment. Updated section content.
Updated reference to the Product Compatibility and Download Center (PCDC) in the Operating Systems section.
Updated supported file formats in the Importing and Exporting Data section.
Updated section. title and content. Added links to software publications in the Software Licenses section.
Updated table in the Ethernet Communication Protocols section.
Added IMPORTANT and ATTENTION tables with information on supported languages in the Programming Language Support section.
Updated reference to the Product Compatibility and Download Center (PCDC) in the Specify software requirements section.
Updated security steps in the System Security section.
Updated suggested range of values in the Digital Input Field Loop Circuits section.
Removed row for T9085. Added row for T9090, removed rows for T9901…T9906, in the Software section.
Removed **NFPA 87** from Glossary.
Updated definition for **proof test** in Glossary.

ICSTT-RM448L-EN-P, July 2019

Change
Updated for Release 1.34 IEC 61508 Edition 2.0 certification

ICSTT-RM448K-EN-P, November 2018

Change
Updates to catalog numbers, ATEX and IECEx UL certificates, and module label

ICSTT-RM448J-EN-P, April 2018

Change
Update for AADvance Release 1.40

Issue 11, May 2015

Change
Correct Documentation Feedback URL and Issue Record

Issue 10, March 2015

Change
Updates for Release 1.34.

Issue 09, May 2014

Change
Updates for UL ATEX/IECEx Certification and T9892 information.

Issue 08, July 2012

Change
Updates for release 1.3 and 1.31

Issue 07, August 2011

Change
Updated for UL Requirements

Issue 06, March 2011

Change
Updated for Release 1.2

Issue 05, October 2010

Change
Updates for UL Certification

Issue 04, July 2010

Change
Update for Release 1.1.1

Issue 03, November 2009

Change
Update for Release 1.1

Issue 02, February 2009

Change
Update for Product Titles

Issue 01, April 2008

Change
First Issue

Notes:

The following terms and abbreviations are used throughout this manual. For definitions of terms not listed here, refer to the Allen-Bradley Industrial Automation Glossary, publication [AG-7.1](#).

A

accuracy The degree of conformity of a measure to a standard or a true value. See also 'resolution'.

achievable safe state A safe state that is achievable.

> **NOTE** Sometimes, a safe state cannot be achieved. An example is a non-recoverable fault such as a voting element with a shorted switch and no means to bypass the effect of the short.

actuator A device which cause an electrical, mechanical or pneumatic action to occur when required within a plant component. Examples are valves and pumps.

AITA Analogue input termination assembly.

alarms and events (AE) An OPC data type that provides time stamped alarm and event notifications.

allotted process safety time The portion of the total process safety time allotted to a sub function of that process.

application software Software specific to the user application, typically using logic sequences, limits and expressions to read inputs, make decisions and control outputs to suit the requirements of the system for functional safety.

architecture Organizational structure of a computing system which describes the functional relationship between board level, device level and system level components.

asynchronous A data communications term describing a serial transmission protocol. A start signal is sent before each byte or character and a stop signal is sent after each byte or character. An example is ASCII over RS-232-C. See also 'RS-232-C, RS-422, RS-485'.

availability The probability that a system will be able to carry out its designated function when required for use — normally expressed as a percentage.

B

backplane clip A sprung, plastic device to hold together two adjacent AADvance® base units. Part number T9904. Used in pairs.

base unit One of two designs which form the supporting parts of an AADvance controller. See 'I/O base unit' and 'processor base unit'.

bindings Bindings describe a "relationship" between variables in different AADvance controllers. Once a variable is "bound" to another variable, a unique and strong relationships is created between the two variables and the SIL 3 Certified SNCP protocol is used to verify that the consuming variable is updated with the data from the producing variable.

black channel A communication path whose layer (i.e. cabling, connections, media converters, routers/switches and associated firmware/software, etc.) has no requirement to maintain the integrity of safety critical data transferred over it. Measures to detect and compensate for any errors introduced into the black channel must be implemented by the safety critical sender and receiver (by software and/or hardware means) to make sure the data retains its integrity.

blanking cover A plastic moulding to hide an unused slot in an AADvance base unit.

boolean A type of variable that can accept only the values 'true' and 'false'.

BPCS Basic process control system. A system which responds to input signals and generates output signals causing a process and associated equipment to operate in a desired manner, but which does not perform any safety instrumented functions with a claimed safety integrity level of 1 or higher.

Refer to IEC 61511 or to ANSI/ISA—84.00.01—2004 Part 1 (IEC 61511-1 Mod) for a formal definition.

Equivalent to the Process Control System (PCS) defined by IEC 61508.

breakdown voltage The maximum voltage (AC or DC) that can be continuously applied between isolated circuits without a breakdown occurring.

BS EN 54 A standard for fire detection and fire alarm systems.

BS EN 60204 A standard for the electrical equipment of machines, which promotes the safety of persons and property, consistency of control response and ease of maintenance.

bus A group of conductors which carry related data. Typically allocated to address, data and control functions in a microprocessor-based system.

bus arbitration A mechanism for deciding which device has control of a bus.

C

CIP Common Industrial Protocol. A communications protocol, formally known as 'CIP™ over Ethernet/IP™', created by Rockwell Automation for the Logix controller family, and which is also supported by the AADvance controller. AADvance controllers use the protocol to exchange data with Logix controllers. The data exchange uses a consumer/producer model.

clearance The shortest distance in air between two conductive parts.

coding peg   A polarization key, fitted to the T9100 processor base unit and to each termination assembly, which verifies that only a module of the correct type may be fitted in a particular slot. Part number T9903.

coil   In IEC 61131-3, a graphical component of a Ladder Diagram program, which represents the assignment of an output variable. In MODBUS language, a discrete output value.

Compiler Verification Tool (CVT)   An automatic software utility that validates the output of the application compilation process.

configuration   A grouping of all the application software and settings for a particular AADvance controller. The grouping must have a 'target', but for an AADvance controller it can have only one 'resource'.

consumer   The consuming controller requests the tag from the producing controller.

contact   A graphical component of a Ladder Diagram program, which represents the status of an input variable.

continuous mode   Where the Safety Instrumented Function in the Safety System is continually maintaining the process in a safe state.

controller   A logic solver; the combination of application execution engine and I/O hardware.

controller system   One or more controllers, their power sources, communications networks and computers.

coverage   The percentage of faults that will be detected by automated diagnostics. See also 'SFF'.

creepage distance   The shortest distance along the surface of an insulating material between two conductive parts.

cross reference   Information calculated by the AADvance® Workbench software or AADvance®-Trusted® SIS Workstation software relating to the dictionary of variables and where those variables are used in a project.

D

data access (DA)   An OPC data type that provides real-time data from AADvance controllers to OPC clients.

de-energize to action   A safety instrumented function circuit where the devices are energized under normal operation. Removal of power de-activates the field devices.

dictionary   The set of internal input and output variables and defined words used in a program.

discrepancy   A condition that exists if one or more of the elements disagree.

DITA   Digital input termination assembly.

DOTA Digital output termination assembly.

E

element A set of input conditioning, application processing and output conditioning.

energize to action A safety instrumented function circuit where the outputs and devices are de-energized under normal operation. Application of power activates the field device.

EUC Equipment Under Control. The machinery, apparatus or plant used for manufacturing, process, transportation, medical or other activities.

expansion cable assembly A flexible interconnection carrying bus signals and power supplies between AADvance base units, available in a variety of lengths. Used in conjunction with a cable socket assembly (at the left hand side of a base unit) and a cable plug assembly (at the right hand side of a base unit).

F

fail operational state A state in which the fault has been masked. See 'fault tolerant'.

fail safe The capability to go to a pre-determined safe state in the event of a specific malfunction.

fault reset button The momentary action push switch located on the front panel of the T9110 processor module.

fault tolerance Built-in capability of a system to provide continued correct execution of its assigned function in the presence of a limited number of hardware and software faults.

fault tolerant The capability to accept the effect of a single arbitrary fault and continue correct operation.

fault warning receiving station A centre from which the necessary corrective measures can be initiated.

fault warning routing equipment Intermediate equipment which routes a fault warning signal from the control and indicating equipment to a fault warning receiving station.

field device Item of equipment connected to the field side of the I/O terminals. Such equipment includes field wiring, sensors, final control elements and those operator interface devices hard-wired to I/O terminals.

fire alarm device A component of a fire alarm system, not incorporated in the control and indicating equipment which is used to give a warning of fire — for example a sounder or visual indicator.

fire alarm receiving station A centre from which the necessary fire protection or fire fighting measures can be initiated at any time.

fire alarm routing equipment Intermediate equipment which routes an alarm signal from control and indicating equipment to a fire alarm receiving station.

function block diagram An IEC 61131 language that describes a function between input variables and output variables. Input and output variables are connected to blocks by connection lines. See 'limited variability language'.

functional safety The ability of a system to carry out the actions necessary to achieve or to maintain a safe state for the process and its associated equipment.

G

group A collection of two or three input modules (or two output modules), arranged together to provide enhanced availability for their respective input or output channels.

H

hand-held equipment Equipment which is intended to be held in one hand while being operated with the other hand.

HART HART (Highway Addressable Remote Transducer) is an open protocol for process control instrumentation. It combines digital signals with analogue signals to provide field device control and status information. The HART protocol also provides diagnostic data. (For more details of HART devices refer to the HART Application Guide, created by the HART Communication Foundation, and their detailed HART specifications. You can download documents from www.hartcomm.org.)

high demand mode Where the Safety Instrumented Function in the Safety System only performs its designed function on a demand, and the frequency of demands is greater than one per year.

hot swap See live insertion.

I

I/O base unit A backplane assembly which holds up to three I/O modules and their associated termination assembly or assemblies in an AADvance controller. Part number T9300. See 'I/O module' and 'termination assembly'.

I/O module A collation of interfaces for field sensors (inputs) or final elements (outputs), arranged in a self-contained and standardized physical form factor.

IEC 61000 A series of international standards giving test and measurement techniques for electromagnetic compatibility.

IEC 61131 An international standard defining programming languages, electrical parameters and environmental conditions for programmable logic controllers. Part 3, which is entitled 'Programming Languages', defines several limited variability languages.

IEC 61508 An international standard for functional safety, encompassing electrical, electronic and programmable electronic systems; hardware and software aspects.

IEC 61511 An international standard for functional safety and safety instrumented systems (SIS) for the process industry, encompassing electrical, electronic and programmable electronic systems, hardware and software aspects.

indicator A device which can change its state to give information.

input (variable) A value passed from an I/O module to the processor module.

instruction list An IEC 61131 language, similar to the simple textual language of PLCs. See 'limited variability language'.

integer A variable type defined by the IEC 61131 standard.

IXL IXL stands for ISaGRAF® eXchange Layer. This is the communication protocol between ISaGRAF based components.

K

key connector The receptacle on the AADvance controller for the program enable key. A 9-way 'D' type socket, located on the T9100 processor base unit.

L

ladder diagram An IEC 61131 language composed of contact symbols representing logical equations and simple actions. The main function is to control outputs based on input conditions. See 'limited variability language'.

LAN Local area network. A computer network covering a small physical area, characterised by a limited geographic range and lack of a need for leased telecommunication lines.

live insertion The removal and then reinsertion of an electronic module into a system while the system remains powered. The assumption is that removal of the module and reinsertion will cause no electrical harm to the system. Also referred to as 'hot swap'.

low demand mode Where the Safety Instrumented Function only performs its designed function on demand, and the frequency of demands is no greater than one per year.

M

manual call point A component of a fire detection and fire alarm system which is used for the manual initiation of an alarm.

MODBUS An industry standard communications protocol developed by Modicon. Used to communicate with external devices such as distributed control systems or operator interfaces.

MODBUS object Represents the configuration settings for a MODBUS Master or for its associated slave links in the AADvance Workbench software or AADvance-Trusted SIS Workstation software. The settings include communication settings and messages.

module locking screw The AADvance latch mechanism seen on the front panel of each module and operated by a broad, flat-blade screwdriver. Uses a cam action to lock to the processor base unit or I/O base unit.

N

NFPA 85 The Boiler and Combustion Systems Hazards Code. Applies to certain boilers, stokers, fuel systems, and steam generators. The purpose of this code is to contribute to operating safety and to help prevent uncontrolled fires, explosions, and implosions.

NFPA 86 A standard for Ovens and Furnaces. Provides the requirements for the prevention of fire and explosion hazards in associated with heat processing of materials in ovens, furnaces and related equipment.

O

on-line The state of a controller that is executing the application software.

OPC A series of standards specifications which support open connectivity in industrial automation.

output (variable) A value passed from the processor module to an I/O module.

P

peer to peer A Peer to Peer network consists of one or more Ethernet networks connecting together a series of AADvance and/or Trusted® controllers to enable application data to be passed between them.

pinging In MODBUS communications, sending the diagnostic Query Data command over a link and by receiving a reply ensuring that the link is healthy and the controller is able to communicate with the master. No process data is

transferred or modified. In the case of slave devices that will not support pinging then the Standby command will default to Inactive state, but no error will be returned.

portable equipment   Enclosed equipment that is moved while in operation or which can easily be moved from one place to another while connected to the supply. Examples are programming and debugging tools and test equipment.

process safety time (PST)   For equipment under control this represents the period of time a dangerous condition can exist without the protection of a safety instrumented system before a hazardous event occurs.

processor base unit   A backplane assembly which holds all of the processor modules in an AADvance controller. Part number T9100. See also 'processor module'.

processor module   The application execution engine of the AADvance controller, housed in a self-contained and standardized physical form factor.

producer   A controller producing a tag to one or more consumers, at the request of the consumers.

program enable key   A security device that protects the application from unauthorized access and change, in the form factor of a 9-way 'D' type plug. Part number T9906. Supplied with the processor base unit. See also 'key connector'.

project   A collection of configurations and the definition of the linking between them. See 'configuration'.

proof test   A periodic test performed to detect dangerous hidden faults in a safety instrumented system (SIS) so that, if necessary, a repair can restore the system to an 'as new' condition or as close as practical to this condition.

> Proof tests are designed to reveal both Systematic and Random failures, Proof tests may be required depending on how the technology has been implemented.
>
> AADvance product data is given for a Useful Life of 20 years. For a Mission Time of up to 20 Years, proof testing is not required. For Mission Times greater than 20 years, any products that are still in service once that time is reached should be replaced.

protocol   A set of rules that is used by devices (such as AADvance controllers, serial devices and engineering computers) to communicate with each other. The rules encompass electrical parameters, data representation, signalling, authentication, and error detection. Examples include MODBUS, TCP and IP.

PST   Process Safety Time. The process safety time for the equipment under control (denoted PSTEUC) is the period a dangerous condition can exist before a hazardous event occurs without a safety system as a protection.

R

real   A class of analogue variable stored in a floating, single-precision 32-bit format.

redundancy The use of two or more devices, each carrying out the same function, to improve reliability or availability.

resolution The smallest interval measurable by an instrument; the level of detail which may be represented. For example, 12 bits can distinguish between 4096 values.

RS-232-C, RS-422, RS-485 Standard interfaces introduced by the Electronic Industries Alliance covering the electrical connection between data communication equipment. RS-232-C is the most commonly used interface; RS-422 and RS-485 allow for higher transmission rates over increased distances.

RTC Real-time clock.

RTU Remote terminal unit. The MODBUS protocol supported by the AADvance controller for MODBUS communications over serial links, with the ability to multi-drop to multiple slave devices.

S

safe state A state which enables the execution of a process demand. Usually entered after the detection of a fault condition; it makes sure the effect of the fault is to enable rather than disable a process demand.

safety accuracy The accuracy of a signal within which the signal is guaranteed to be free of dangerous faults. If the signal drifts outside of this range, it is declared faulty.

safety-critical state A faulted state which prevents the execution of a process demand.

sensor A device or combination of devices that measure a process condition. Examples are transmitters, transducers, process switches and position switches.

sequential function chart An IEC 61131 language that divides the process cycle into a number of well-defined steps separated by transitions. See 'limited variability language'.

SFF Safe Failure Fraction. Given by (the sum of the rate of safe failures plus the rate of detected dangerous failures) divided by (the sum of the rate of safe failures plus the rate of detected and undetected dangerous failures).

SIF Safety Instrumented Function. A form of process control that performs specified functions to achieve or maintain a safe state of a process when unacceptable or dangerous process conditions are detected.

SIL Safety Integrity Level. One of four possible discrete levels, defined in IEC 61508 and IEC 61511, for specifying the safety integrity requirements of the safety functions to be allocated to a safety-related system. SIL4 has the highest level of safety integrity; SIL1 has the lowest.

The whole of an installation (of which the AADvance system forms a part) must meet these requirements in order to achieve an overall SIL rating.

SNCP SNCP (Safety Network Control Protocol) is the Safety Protocol that allows elements of an AADvance System to exchange data. SNCP is a SIL 3 certified

protocol which provides a safety layer for the Ethernet network making it a "Black Channel".

SNTP   Simple Network Time Protocol. Used for synchronizing the clocks of computer systems over packet-switched, variable-latency data networks.

structured text   A high level IEC 61131-3 language with syntax similar to Pascal. Used mainly to implement complex procedures that cannot be expressed easily with graphical languages.

synchronous   A data communications term describing a serial transmission protocol. A pre-arranged number of bits is expected to be sent across a line per second. To synchronise the sending and receiving machines, a clocking signal is sent by the transmitting computer. There are no start or stop bits.

T

TA   See 'termination assembly'.

target   An attribute of a 'configuration' which describes characteristics of the AADvance controller on which the configuration will run. Includes characteristics such as the memory model and the sizes of variable types for the controller.

TCP   Transmission control protocol. One of the core protocols of the Internet Protocol suite. It provides reliable, ordered delivery of a stream of bytes from a program on one computer to another program on another computer. Common applications include the World Wide Web, e-mail and file transfer and, for an AADvance controller, MODBUS communications over Ethernet.

termination assembly   A printed circuit board which connects field wiring to an input or output module. The circuit includes fuses for field circuits. The board carries screw terminals to connect field wiring to the controller, and the whole assembly clips onto the 9300 I/O base unit.

TMR   Triple modular redundant. A fault tolerant arrangement in which three systems carry out a process and their result is processed by a voting system to produce a single output.

TÜV certification   Independent third party certification against a defined range of international standards including IEC 61508.

U

U   Rack unit. A unit of measure used to describe the height of equipment intended for mounting in a standard rack. Equivalent to 44.45mm (1-¾ inches).

V

validation In quality assurance, confirmation that the product does what the user requires.

verification In quality assurance, confirmation that the product conforms to the specifications.

voting system A redundant system (m out of n) which requires at least m of the n channels to be in agreement before the system can take action.

W

withstand voltage The maximum voltage level that can be applied between circuits or components without causing a breakdown.

Notes:

Rockwell Automation Support

Use these resources to access support information.

Technical Support Center	Find help with how-to videos, FAQs, chat, user forums, and product notification updates.	rok.auto/support
Knowledgebase	Access Knowledgebase articles.	rok.auto/knowledgebase
Local Technical Support Phone Numbers	Locate the telephone number for your country.	rok.auto/phonesupport
Literature Library	Find installation instructions, manuals, brochures, and technical data publications.	rok.auto/literature
Product Compatibility and Download Center (PCDC)	Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes.	rok.auto/pcdc

Documentation Feedback

Your comments help us serve your documentation needs better. If you have any suggestions on how to improve our content, complete the form at rok.auto/docfeedback.

Waste Electrical and Electronic Equipment (WEEE)

At the end of life, this equipment should be collected separately from any unsorted municipal waste.

Rockwell Automation maintains current product environmental information on its website at rok.auto/pec.

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