Manual

HIMax®

Maintenance Manual

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Document designation	Description
HI 801 170 D, Rev. 1.03 (1927)	German original document
HI 801 171 E, Rev. 1.03.00 (1934)	English translation of the German original document

Table of Contents

1 Introduction

This document describes all relevant activities for servicing and operating safety-related HIMax controllers.

- Chapter 2 lists the activities in a tabular overview.
- Chapter 3 describes the proof test.
- Chapter 4 lists the manuals to be observed and other applicable documents.
- Chapter 5 includes maintenance action details.

1.1 Target Audience and Required Know-How

This manual is aimed at the planners, design engineers, programmers and maintenance personnel of automation systems. Specialized knowledge of safety-related automation systems is required.

Additional knowledge is necessary for maintenance activities on the HIMax system hardware and software, e.g., for reading and evaluating diagnostics.

For work on safety-related automation systems, the safety standards demand proof of the qualifications required for maintenance personnel.

Qualified HIMA service personnel can be requested to perform maintenance tasks in accordance with the manufacturer's instructions. HIMA also offers specific training seminars to qualify the maintenance personnel.

HIMA recommends the following seminars for performing maintenance tasks:

- **FS 101** Functional safety for maintenance and operation
- **PT 220** SILworX HIMax Maintenance

1.2 Writing Conventions

To ensure improved readability and comprehensibility, the following writing conventions are used in this document:

Bold	To highlight important parts. Names of buttons, menu functions and tabs that can be clicked and used in the programming tool.
Italics	Parameters and system variables, references.
`Courier`	Literal user inputs.
RUN	Operating states are designated by capitals.
Chapter 1.2.3	Cross-references are hyperlinks even if they are not specially marked. In the electronic document (PDF): When the mouse pointer hovers over a hyperlink, it changes its shape. Click the hyperlink to jump to the corresponding position.

Safety notices and operating tips are specially marked.

1.2.1 Safety Notices

Safety notices must be strictly observed to ensure the lowest possible risk.

The safety notices are represented as described below.

- Signal word: warning, caution, notice.
- Type and source of risk.
- Consequences arising from non-observance.
- Risk prevention.

The signal words have the following meanings:

- Warning indicates hazardous situations which, if not avoided, could result in death or serious injury.
- Caution indicates hazardous situation which, if not avoided, could result in minor or moderate injury.
- Notice indicates a hazardous situation which, if not avoided, could result in property damage.

⚠ SIGNAL WORD

Type and source of risk!

Consequences arising from non-observance.

Risk prevention.

NOTICE

Type and source of damage!

Damage prevention.

1.2.2 Operating Tips

Additional information is structured as presented in the following example:

i The text giving additional information is located here.

Useful tips and tricks appear as follows:

TIP The tip text is located here.

1.3 Safety Lifecycle Services

HIMA provides support throughout all the phases of the plant's safety lifecycle, from planning and engineering through commissioning to maintenance of safety and security.

HIMA's technical support experts are available for providing information and answering questions about our products, functional safety and automation security.

To achieve the qualification required by the safety standards, HIMA offers product or customer-specific seminars at HIMA's training center or on site at the customer's premises. The current seminar program for functional safety, automation security and HIMA products can be found on HIMA's website.

Safety Lifecycle Services:	
Onsite+ / On-Site Engineering	In close cooperation with the customer, HIMA performs changes or extensions on site.
Startup+ / Preventive Maintenance	HIMA is responsible for planning and executing preventive maintenance measures. Maintenance actions are carried out in accordance with the manufacturer's specifications and are documented for the customer.
Lifecycle+ / Lifecycle Management	As part of its lifecycle management processes, HIMA analyzes the current status of all installed systems and develops specific recommendations for maintenance, upgrading and migration.
Hotline+ / 24 h Hotline	HIMA's safety engineers are available by telephone around the clock to help solve problems.
Standby+ / 24 h Call-Out Service	Faults that cannot be resolved over the phone are processed by HIMA's specialists within the time frame specified in the contract.
Logistics+/ 24 h Spare Parts Service	HIMA maintains an inventory of necessary spare parts and guarantees quick, long-term availability.

Contact details:	
Safety Lifecycle Services	https://www.hima.com/en/about-hima/contacts-worldwide/
Technical Support	https://www.hima.com/en/products-services/support/
Seminar Program	https://www.hima.com/en/products-services/seminars//

2 Operating and Maintenance Activities

The operating and maintenance activities of the individual system components are listed in the following sections.

2.1 Activities Recurring in the Short Term

The HIMax system must be tested by the operator at short recurring intervals in line with the Automation Security policy. The operator must specify the test details in a security risk analysis; refer to the automation security manual (HI 801 373 E).

2.2 Activities Recurring on an Annual Basis

The chapter specifies the maintenance activities recurring on an annual basis.

2.2.1 Mechanical Test (Visual Inspection)

The table specifies the maintenance activities for the mechanics:

Activity	Who	Reference
Check the module screws for firm connection, tighten if necessary.	Operating company, assembler, maintenance personnel	D1, Chapter 5.2
Check the cable plug screws for firm connection, tighten if necessary.	Operating company, assembler, maintenance personnel	D1
Check the data cables for firm connection, including to the communication modules.	Operating company, assembler, maintenance personnel	D1

Table 1: Annual Activities for the Mechanics

2.2.2 Power Supply Test

The table specifies the maintenance activities for the power supply:

Activity	Who	Reference
Check the 230 VAC/24 VDC power supply for compliance with tolerances, 24 VDC, -15…+20 %, $r_p \leq 5$ %.	Operating company, assembler, maintenance personnel	D1
Visually check the 24 VDC distribution. Check any existing decoupling diodes for proper function.	Operating company, assembler, maintenance personnel	D1
Check the redundant supply for proper function.	Operating company, assembler, maintenance personnel	D1

Table 2: Annual Activities for the Power Supply

2.3 Activities Recurring in the Long Term

The chapter specifies maintenance activities recurring in the long term.

2.3.1 Hardware

The table specifies the activities for the hardware:

Activity	Who	Reference
At an operating temperature of > 40 °C: Replace the system fans every **3** years.	Operating company, assembler, maintenance personnel	D7
At an operating temperature of ≤ 40 °C: Replace the system fans every **6** years.	Operating company, assembler, maintenance personnel	D7
X-FILTER 01: Every **10** years	Operating company, assembler, maintenance personnel	Chapter 5.5.1

Table 3: Activities for the Hardware Recurring in the Long Term

2.3.2 Proof Test

The table specifies the activities for the proof test:

Activity	Who	Reference
The proof test interval must be in accordance with the interval required by the application-specific safety integrity level (SIL). The complete safety functions within the HIMA safety-related system must be checked during the proof test.	Operating company, assembler, maintenance personnel	N2, D2, Chapter 5.2

Table 4: Proof Test

2.4 Activities as Required

The chapter specifies activities to be carried out as required.

2.4.1 Hardware

The table specifies the activities for the hardware:

Activity	Who	Reference
Replace the modules.	Operating company, assembler, maintenance personnel	D1, D2, D6 Chapter 5.2

Table 5: Activities for the Hardware to be Carried out as Required

Only personnel with knowledge of ESD protective measures may modify or extend the system or replace modules.

NOTICE

Damage due to electrostatic discharge!

- **When performing the work, make sure that the workspace is free of static, and wear a grounding strap.**
- **If not used, ensure that the component is protected from electrostatic discharge, e.g., by storing it in its packaging.**

2.4.2 Software

The table specifies the activities for the software:

Activity	Who	Reference
Loading the user program.	Operating company, assembler, maintenance personnel	D1
Load new operating systems.	Operating company, assembler, maintenance personnel	D1, Chapter 5.3
Change the system parameters.	Operating company, assembler, maintenance personnel	D1, D2, D5, D6

Table 6: Activities for the Software to be Carried out as Required

3 Proof Test (in Accordance with IEC 61508)

HIMA safety systems must be subject to a proof test in regular intervals. The proof test interval for HIMA controllers must be in accordance with the interval required by the application-specific safety integrity level (SIL). The proof test must comply with the applicable safety standards.

Refer to the functional safety data manual (HI 801 317 E) for the safety-related characteristic values of HIMA's HIMax system.

3.1 Proof Testing

The proof test is performed by powering off and on again the controller. When restarting, all electronic components in the controller, e.g., memory and processors, are initialized and all diagnostic tests are processed simultaneously.

To perform the proof test

1. Power off the controller (Power OFF).
2. Power on the controller (Power ON).
   ☑ Restart completed.
3. After the restart, read the following diagnostic information and check for error messages:
   - LEDs on the modules.
   - Warning and error counters in the Control Panel.
   - Diagnostic files of the processor modules.

Proof test as a part of the functional test (loop test)

Proof testing can be dispensed with if the the complete safety functions between field level and controller are tested with sufficient testing depth within the specified intervals. The test of the complete safety functions includes all field devices connected to the controller, such as sensors and actuators. Additionally, the test covers the controller in use and the signal processing in the controller.

When testing analog signals in HIMax modules, a sufficient testing depth is achieved by:

- Running through the nominal range, e.g., 0/4…20 mA, and simultaneously checking the switching thresholds.
- Underrunning the open-circuit limit, e.g., ≤ 3.6 mA.
- Overrunning the short-circuit limit, e.g., ≥ 21.0 mA.

When testing binary signals in HIMax modules, a sufficient testing depth is achieved by:

- Checking the switching thresholds for high and low levels.
- Checking for open-circuits, if possible.
- Checking for short-circuits, if possible.

When testing counter signals in HIMax modules, a sufficient testing depth is achieved by:

- Checking the switching thresholds for high and low levels.
- Checing the signal nominal range at 1 %, 10 %, 50 % and 100 %.
- Checking for open-circuits (line breaks), if possible.
- Checking for short-circuits, if possible.

The frequency values, in particular the error bits and value changes, must be checked and documented for 30 s each.

While testing the complete safety functions, the controller's response must be monitored using the SILworX programming tool. Significant channel information such as error states, channel values, open-circuits or short-circuits, must be monitored and documented.

If errors occur, they must be promptly removed (< MTTR for high demand mode) and the corresponding tests must be repeated.

4 Other Applicable Documents

The following table specifies other applicable documents.

Reference	Standard/Document ID	Description
N1	IEC 61511-1, Section 12	Functional safety - Safety instrumented systems for the process industry sector - Part 1: Framework, definitions, system, hardware and software requirements
N2	IEC 61508-4, Section 3.8.5	Proof test
D1	HI 801 001 E	HIMax system manual
D2	HI 801 003 E	HIMax safety manual
D3	HI 801 317 E	HIMax functional safety data manual
D4	HI 801 373 E	Automation security manual
D5	---	SILworX online help
Reference	Standard/Document ID	Description
D6	**HIMax module manuals**	
	HI 801 179 E	X-AI 16 51 module manual
	HI 801 021 E	X-AI 32 01 module manual
	HI 801 055 E	X-AI 32 02 SOE module manual
	HI 801 111 E	X-AO 16 01 module manual
	HI 801 113 E	X-CI 24 01 module manual
	HI 801 011 E	X-COM 01 module manual
	HI 801 009 E	X-CPU 01 module manual
	HI 801 355 E	X-CPU 31 module manual
	HI 801 057 E	X-DI 16 01 module manual
	HI 801 015 E	X-DI 32 01 module manual
	HI 801 017 E	X-DI 32 02 module manual
	HI 801 059 E	X-DI 32 03 module manual
	HI 801 051 E	X-DI 32 04 SOE module manual
	HI 801 053 E	X-DI 32 05 SOE module manual
	HI 801 091 E	X-DI 64 01 module manual
	HI 801 023 E	X-DO 12 01 module manual
	HI 801 099 E	X-DO 12 02 module manual
	HI 801 019 E	X-DO 24 01 module manual
	HI 801 095 E	X-DO 24 02 module manual
	HI 801 097 E	X-DO 32 01 module manual
	HI 801 307 E	X-HART 01 module manual
	HI 801 305 E	X-MIO 7/6 01 module manual
	HI 801 007 E	X-SB 01 module manual

Reference	Standard/Document ID	Description
D7	**Additional Manuals**	
	HI 801 031 E	X-FAN manual
	HI 801 025 E	X-BASE PLATE 01 manual
	HI 801 371 E	X-BASE PLATE 31 manual
	HI 801 115 E	X-FTA 001 01 manual
	HI 801 131 E	X-FTA 001 02 manual
	HI 801 117 E	X-FTA 002 01 manual
	HI 801 119 E	X-FTA 002 02 manual
	HI 801 121 E	X-FTA 003 02 manual
	HI 801 125 E	X-FTA 005 02 manual
	HI 801 127 E	X-FTA 006 01 manual
	HI 801 129 E	X-FTA 006 02 manual
	HI 801 133 E	X-FTA 007 02 manual
	HI 801 135 E	X-FTA 008 02 manual
	HI 801 137 E	X-FTA 009 02 manual

Table 7: Other Applicable Documentation

5 Maintenance Actions in Details

This chapter describes the maintenance actions for the components of the HIMax system.

i Only qualified personnel may perform maintenance actions to supply, signal and data lines, taking all ESD protection measures into account. Personnel must be electrostatically discharged prior to any direct contact with these supply or signal lines!

5.1 Replacing the System Fans

The frequency for replacing the fans depends on the operating temperature.

HIMA recommends replacing the system fans in intervals in accordance with Table 3:

5.2 Replacing the Modules

Defective modules must be replaced with modules of the same type or with approved replacement models.

When replacing modules, observe the instructions specified in the HIMax system manual (HI 801 001 E) and HIMax safety manual (HI 801 003 E).

The HIMax system allows for redundant module operation. If a redundant module is available, a module can be replaced during operation while maintaining the fully system functionality.

Make sure that the redundant module is operating without malfunction. To this end, observe the LEDs:

- The green *RUN* LED must be lit.
- The red *Error* LED must neither be lit nor be blinking.

Replacing a non-redundant module during operation can impair the functionality of the controller or even cause it to fail.

Prior to replacing a module, take all potential effects on the entire process into account. If necessary, further technical and organizational measures must be implemented to ensure that the process during the module replacement is sufficiently monitored in terms of safety.

For further details refer to the TÜV document Maintenance Override.

This document is available on the TÜV homepage:

`http://www.tuv-fs.com or`
`http://www.tuvasi.com.`

5.2.1 Mounting and Removing a Module

This chapter describes how to mount and remove the HIMax module. A module can be mounted and removed while the HIMax system is operating.

NOTICE

Damage to bus and power sockets due to module jamming!

Failure to comply with these instructions can damage the controller.

Always insert the module in the base plate carefully.

Tools:

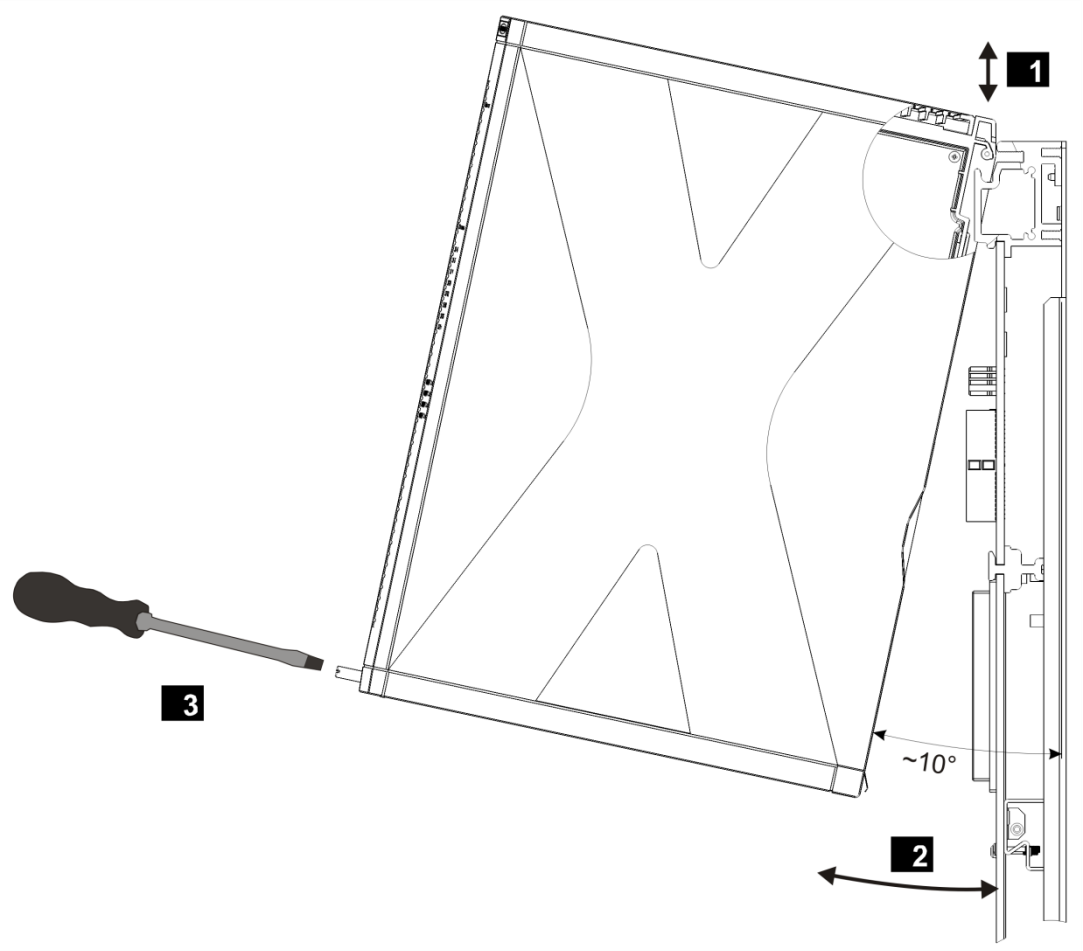
- Screwdriver, slotted 0.8 x 4.0 mm
- Screwdriver, slotted 1.2 x 8.0 mm

Installation

1. Open the cover plate on the fan rack:
   ☑ Move the locks to the *open* position.
   ☑ Lift the cover plate and insert it into the fan rack.
2. Insert the top of the module into the hook-in rail, see 1.
3. Swivel the lower edge of the module towards the base plate and apply light pressure to snap it into place, see 2.
4. Tighten the screws, see 3.
5. Pull the cover plate out of the fan rack and close it.
6. Lock the cover plate.

Removal

1. Open the cover plate on the fan rack:
   ☑ Move the locks to the *open* position.
   ☑ Lift the cover plate and insert it into the fan rack.
2. Release the screw, see 3.
3. Swivel the lower edge of the module away from the base plate. Lift and apply light pressure to remove the module from the hook-in rail, see 2 and 1.
4. Pull the cover plate out of the fan rack and close it.
5. Lock the cover plate.



1 Inserting and removing a module
2 Swiveling the module in and out
3 Securing and releasing a module

Figure 1: Mounting and Removing a Module

i If the HIMax system is operating, do not open the cover plate of the fan rack for more than a few minutes (< 10 min) since this affects the forced cooling.

5.3 Loading Operating Systems

As part of product maintenance, HIMA is continuously improving the operating systems of the modules. HIMA recommends using system downtimes to load the current version of the operating system into the modules.

The module must be in the STOP state to be able to load an operating system.

i The current operating system versions of modules are displayed in the SILworX Control Panel. The type label specifies the delivered module version.

If the module to be loaded is a system module or a processor module the *Ess* LED must not be lit.

The operating system may be loaded during operation if a redundant module exists for the module to be loaded. The following points must be observed:

- The redundant module must be in the RUN state.
  - The *FAULT* LED must not be lit.
  - The *RUN* LED must be lit.
- The displayed watchdog buffer time must be sufficiently high to allow the transfer of the operating system.

5.3.1 Maintenance Indicators

The maintenance indicator LEDs are labeled *Maint*.

LED	Color	Status	Description
Force	Yellow	On	▪ Forcing prepared, but no local or global variables are currently being forced. Example: the force switch for a variable is set, the force main switch is still deactivated. The module is in the STOP, RUN or RUN / UP STOP state. ▪ The emergency loader is active.
		Blinking1	Forcing is active: At least one local or global variable has adopted the corresponding force value.
		Off	Forcing not active.
Test	Yellow	On	▪ Connection to the PADT with write permission. ▪ The emergency loader is active.
		Blinking1	At least one user program is in the RUN_FREEZE state (single-step mode).
		Off	No connection to the PADT with write permission and no user program in the RUN_FREEZE state.
Prog	Yellow	On	▪ Download (processor module in STOP), the configuration is being loaded. A PADT write command is being processed. ▪ The emergency loader is active.
		Blinking1	Reload procedure active or exchange of configuration data between processor modules.
		Off	No loading procedure active and no configuration data exchange between processor modules.

Table 8: Maintenance Indicators

On processor modules, these LEDs indicate that the PADT used to access the controller is connected. It can thus be recognized if software maintenance actions such as change, extension or test are being performed on the processor modules.

5.4 Field Termination Assemblies

Field termination assemblies are maintenance free. The defective field termination assembly only has to be replaced with a one of the same type or with an approved replacement model if a faults occurs.

While a field termination assembly is being replaced, the connected sensors or actuators are not available. A part of the sensors or actuators were already disrupted due to the failure.

- If sensors or actuators are implemented redundantly, a defective module can be replaced without impairing the system's functionality. This only applies if the following conditions are met:
  - Separate field termination assemblies are used to connect the redundant sensors or actuators.
  - The connection between the redundant sensors or actuators and the processor module is not disrupted.
- If not all the sensors or actuators have been redundantly configured, take all potential effects on the entire process into account. If necessary, further technical and organizational measures must be implemented to ensure that the process during replacement is sufficiently monitored in terms of safety.

Refer to the manual of the corresponding field termination assembly for more details.

5.5 Base Plates

If defective, the base plate must be replaced. The replacement may cause the system buses to other base plates to be interrupted. For this reason, prior to replacing the base plates, think about the consequences that the replacement may have on the entire process in terms of safety and availability. With this in mind, the following actions must be planned:

- When the replacement should be performed (point in time).
- Technical and/or organizational measures to ensure that the process during replacement is sufficiently monitored in terms of safety.

Refer to the manual of the base plate (HI 801 025 E) for more details.

5.5.1 Replacing the X-FILTER 01

The HIMax system must be protected against transient voltage peaks in accordance with the industrial environment. To protect the system on the long term, the mains filters must be replaced depending on their industrial environment, however, after 10 years at the latest.

If energy-rich transient interfering pulses in the voltage supply cannot be excluded, the filters may also be replaced earlier. Interfering pulses slightly reduce filter damping.

HIMA recommends using system downtimes to replace the filters (X-FILTER 01).

To replace X-FILTER 01

Tools, components and utilities

- Magnetized screwdriver, cross PH 1.
- 2 x replacement filters (X-FILTER 01).

⚠ CAUTION

The fastening screw is not connected to the X-FILTER 01. When loosening, it could fall into the systems located underneath.

Use a magnetized screwdriver to replace the X-FILTER 01 filters. The systems located underneath the base plate must be covered accordingly! Use system downtimes to replace the X-FILTER 01 filters.

Procedure:

1. When loosening, take precautionary measures to prevent the fastening screw from falling into the systems located underneath.
2. Use the screwdriver to loosen the fastening screw of the first filter. Keep the fastening screw safe!
3. Remove the filter.
4. Insert the new filter.
5. Reinsert the fastening screw and tighten it.
6. Repeat the procedure for the second filter.

Appendix

Glossary

Term	Description
AI	Analog input
AO	Analog output
ARP	Address resolution protocol, network protocol for assigning the network addresses to hardware addresses
COM	Communication module
CRC	Cyclic redundancy check
DI	Digital input
DO	Digital output
EMC	Electromagnetic compatibility
EN	European standard
ESD	Electrostatic discharge
FB	Fieldbus
FBD	Function block diagrams
HW	Hardware
ICMP	Internet control message protocol, network protocol for status or error messages
IEC	International electrotechnical commission
Interference-free	Inputs are designed for interference-free operation and can be used in circuits with safety functions
MAC	Media access control address, hardware address of one network connection
PADT	Programming and debugging tool (in accordance with IEC 61131-3), PC with SILworX
PELV	Protective extra low voltage
PES	Programmable electronic system
R	Read, the variable is read out
R/W	Read/Write, column title for system variable type
Rack ID	Base plate identification (number)
r_P	Peak value of a total AC component
SB	System bus (module)
SC/OC	Short-circuit/open-circuit
SELV	Safety extra low voltage
SFF	Safe failure fraction, portion of faults that can be safely controlled
SIL	Safety integrity level (in accordance with IEC 61508)
SILworX	Programming tool
SNTP	Simple network time protocol (RFC 1769)
SRS	System.Rack.Slot, addressing of a module
SW	Software
TMO	Timeout
W	Write, the variable receives a value, e.g., from the user program
WD	Watchdog, device for monitoring the system's correct operation. Signal for fault-free process
WDT	Watchdog time

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