

# Serial Watchdog

Documentation and User Manual

Version 1.1



# Serial Watchdog

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## Exclusion of liability

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## Table of Contents

<b>0 INTRODUCTION</b> .....	<b>2</b>
<b>1 INSTALLATION</b> .....	<b>2</b>
1.1 BUILDING A 230V AC WATCHDOG MONITORED SYSTEM WITH UPS .....	2
1.2 BUILDING A 24V DC WATCHDOG MONITORED SYSTEM WITH UPS.....	2
1.3 USING THE RESET SWITCH OF THE COMPUTER .....	2
<b>2 PRINCIPLE OF OPERATION</b> .....	<b>2</b>
2.1 GENERAL SYSTEM BEHAVIOUR .....	2
2.2 SYSTEM BEHAVIOUR AFTER A POWER FAILURE .....	2
<b>3 OPTIONAL FEATURES</b> .....	<b>2</b>
<b>4 TECHNICAL DATA</b> .....	<b>2</b>
4.1 HARDWARE SPECIFICATION .....	2
4.2 SOFTWARE SPECIFICATION.....	2
4.3 COMMAND SET SUMMARY .....	2
4.4 HISTORY .....	2
<b>5 EC COMFORMITY DECLARATION</b> .....	<b>2</b>

*last modified: March 04, 2004  
by Jens Keubler*

# Serial Watchdog

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## 0 Introduction

This document describes the installation and the principle of operation of a watchdog monitored computer system consisting of the GBS-Elektronik Serial Watchdog, an industrial PC and an optional UPS. Such an arrangement is required for autonomously working unattended measurement systems. The UPS buffers a short main power loss and is able to clearly shut down the computer if the main power does not return. During normal operation the Serial Watchdog monitors the computer via the RS232 interface. If the computer hangs because of a software crash or a hardware trouble, the watchdog does not receive the ping signal any longer and tries to restart the computer: First by initiating a Windows Software restart and, if this doesn't work, by breaking its power supply for a short time. A small program runs permanently on the computer in the background and sends periodically the ping signal over the serial port as long as everything works perfectly. The system state is always indicated by several LED's at the watchdog's front and by an external lamp.

The great advantage of the Serial Watchdog is its hardware independence. It is suitable for almost all computers which are equipped with a serial RS232 interface. Other watchdog monitored computer systems require a special computer hard- and software. These systems are often expensive and inflexible.

## 1 Installation

The Serial Watchdog is usable in different situations. It works with 230V AC computers and with 24V DC systems, too. The two most important installation variants are described in this chapter. The watchdog design allows a maximum of flexibility. Dependent on the situation it is possible to modify one of the standard systems.

Mechanical installation of the watchdog unit is easily possible by mounting it on a DIN-Rail. If no DIN-Rail is available or there is not enough space in the facility, the watchdog has to be fastened in any other way dependent on the situation. The open side of the communication cable must be connected to the watchdog as described on the SUB-D9 connector (RxD with RxD...) and the SUB-D9 connector has to be connected to the computer which should be monitored.

If an external State-of-Health lamp is required, connect the middle contact of the corresponding relay (connections at the watchdog's left bottom) with the watchdog's 24V power supply terminal. Dependent on the state which should be indicated, it is necessary to connect the opened or closed relay contact with the lamp. Alternatively it is possible to switch another device via the relay, e.g. an acoustic alarm. If it needs a different operating voltage than 24V DC, supply the middle contact of the relay with the corresponding voltage. Make sure that it does not exceed the maximum ratings of the relay (see Technical Specifications).

Normally the Serial Watchdog is used together with a UPS to buffer power failures. This UPS is not required for proper operation of the watchdog. A UPS is not necessary in facilities where a high main power reliability is guaranteed.

## 1.1 Building a 230V AC watchdog monitored system with UPS

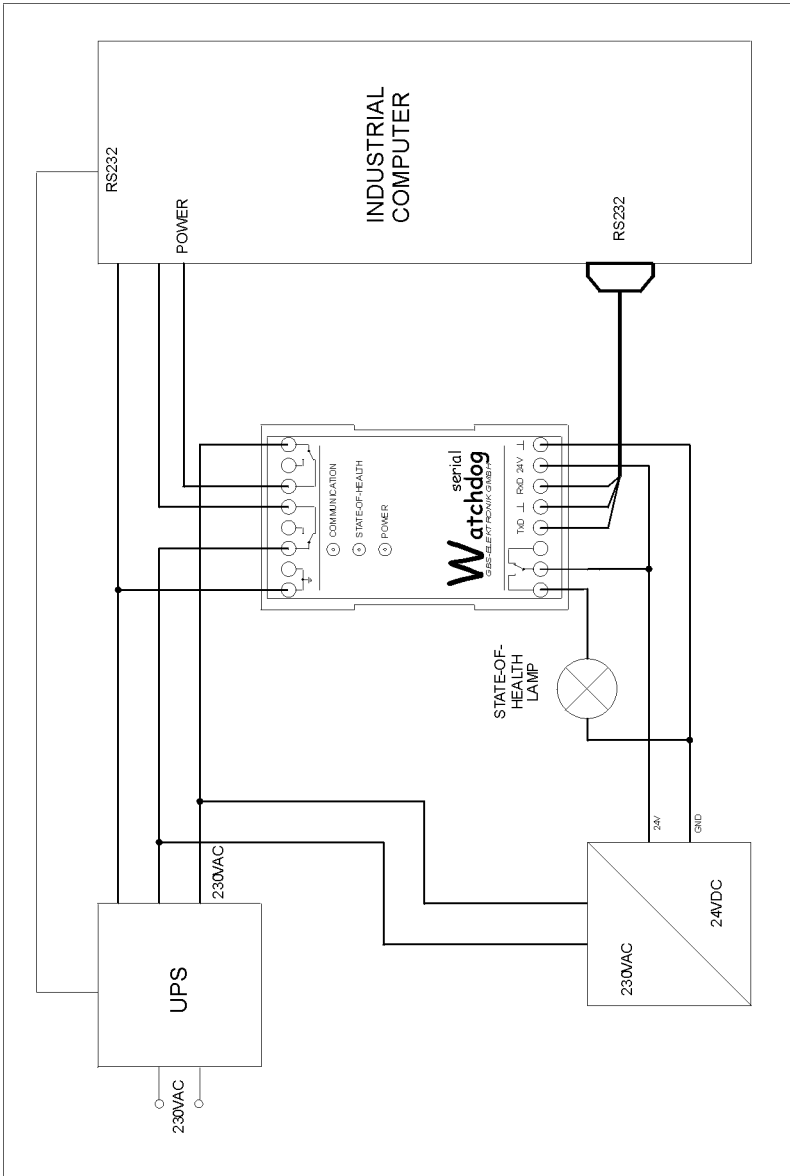
### *Safety Instructions*

Read and follow all of this instructions careful. You work with dangerous voltages. There is the risk of an electrical shock. Before installation make sure that all parts are disconnected from the main supply and powerless! Take special care with the UPS. Note that the UPS output can supply power even if its input is disconnected from the power grid!

In each case the watchdog's earth ground connection has to be wired with the system's protective ground (earth)! Furthermore the computer and the UPS require a professional grounding according to corresponding standards. Only qualified personell is authorized to install such a system.

Figure 1.1 shows the wiring diagram for a 230V AC computer system with UPS and Serial Watchdog. An additional AC/DC voltage converter is necessary to supply the watchdog with 24V DC. Read and follow the instructions given in the user manual / installation guide of the converter module.

# Serial Watchdog



**Figure 1.1** 230V AC system with Serial Watchdog

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*Disclaimer*

Before you supply the whole system with power, carefully check all connections for correctness! The GBS-Elektronik GmbH is not liable for errors and damages caused by wrong use and improper installation of the Serial Watchdog module. Furthermore the GBS-Elektronik GmbH is not liable for indirect or subsequent damages due to wrong installation and malfunction of the Serial Watchdog.

## **1.2 Building a 24V DC watchdog monitored system with UPS**

Figure 1.2 shows a typical 24V DC watchdog monitored computer system with UPS. In this application a 230V AC output UPS is combined with an additional 230V AC / 24V DC converter. Instead of this combination a single 24V DC output UPS can be used. In most cases it is very useful to directly connect the watchdog's power supply with the power relay's middle contacts.

## **1.3 Using the reset switch of the computer**

Another way is to use the computer's reset switch to initialize a reboot. This is only possible with computers which are equipped with a usable reset switch. In this case the power relay of the watchdog is not used to cut the power supply of the computer, but it closes the reset switch for a short time. Note that this works perfectly with a lot of computers, but there are also models (particularly newer ones) which are sometimes immune against a reset. In some special cases (evil hang-up) this computers do not respond to the reset signal.

# Serial Watchdog

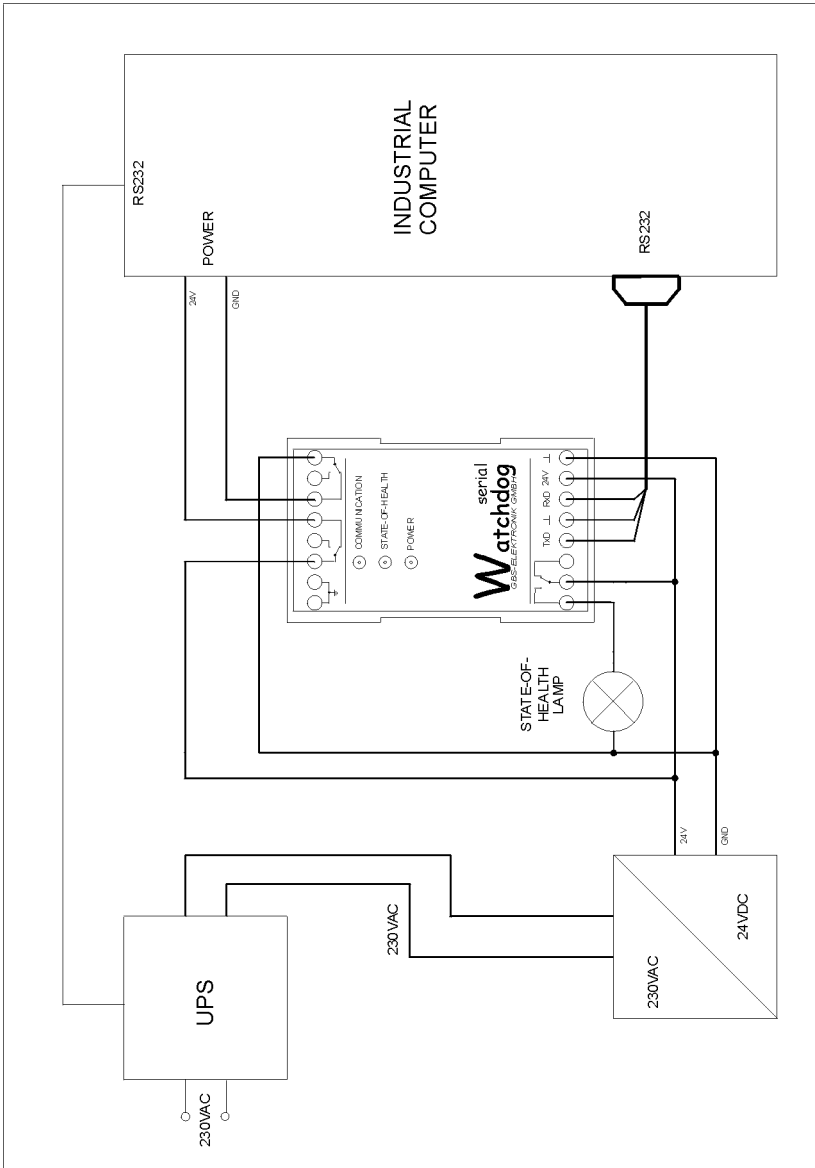


Figure 1.2 24V DC system with Serial Watchdog



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## 2 Principle of Operation

This chapter describes how the Serial Watchdog works. It does not describe the usage and installation of the watchdog program which is necessary to operate the watchdog. For questions concerning this program, please refer to the corresponding user manual / online help.

### 2.1 General system behaviour

After setting up all parameters in the watchdog program, monitoring is activated by pressing the START-button. This sends the START-command to the Serial Watchdog which monitors the computer now. The COMMUNICATION-LED turns on and the STATE-OF-HEALTH-LED starts red flashing. Now the watchdog program sends the PING-command with parameter 0x01 every 30 seconds until the program's timer reaches the preset watchdog time. Every time a file is created within the monitored directory this timer will be cleared and the PING-command with parameter 0x00 is sent to the watchdog. This changes the STATE-OF-HEALTH-LED from red flashing to continuously green. If the timer reaches the preset watchdog time without having detected a file-writing event, the watchdog program stops sending the PING-command and tries to shut down and restart Windows. For safety reasons a fixed 30s overtime period is always added to the preset value. So, for instance, if desired measurement time is 60s, it is recommended to set the watchdog time to the same value, i.e. 60s. Thus, the effective time-out will be  $60+30=90$ s.

Exactly 30 seconds after the last PING-command was received by the watchdog, it changes the STATE-OF-HEALTH-LED to continuously red and generates a periodical acoustic signal if audible alarm is enabled. If no PING-command is received within the next 5 minutes, the watchdog will open the power relay for 40 seconds which acts as a hard reset for the computer. Next the watchdog runs its initialization procedure like described in the chapter „System behaviour after a power failure“. If the operating system isn't in trouble, the computer will finish the reboot within 5 minutes. After a successful reboot the watchdog program will be restarted automatically. It sends immediately the PING-command (with parameter 0x01) to the Serial Watchdog to prevent a hard reset in this moment. Now the next monitoring cycle starts like described above.

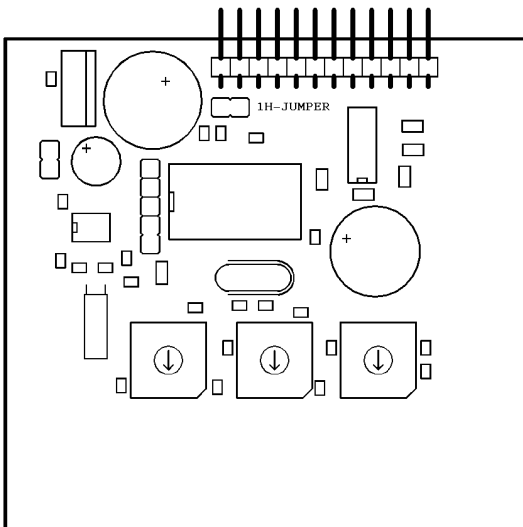
## Serial Watchdog

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The number of soft-restarts (initiated by the watchdog program) can be limited by the parameter „Number of Restarts“. Values between 1 and 255 are valid, zero disables the limit. If the counter reaches the limit, it stops restarting the computer and sends now PING-commands with the parameter 0x02 every 30 seconds. The watchdog module sets the STATE-OF-HEALTH-LED to red and starts a timer which generates a 5 second long acoustic signal every hour if audible alarm is enabled. Every valid file-writing action or the STOP-command will finish this behaviour and clears the counter. During this time the watchdog module monitors the computer. If it stops sending PING-commands (with parameter 0x02) the watchdog module initiates a hard-restart (opens the power relay).

## 2.2 System behaviour after a power failure

If the UPS output supplies the system with power, the computer boots and starts its operating system. Meanwhile the Serial Watchdog runs its initialisation procedure and waits for commands which are sent via the serial port. At this time the POWER-LED is on, the COMMUNICATION-LED is off and the STATE-OF-HEALTH-LED shines red. If the 1H-jumper (located at the watchdog's electronic board, see figure 2) is not closed and no command is received, the watchdog stays in this state as long as power is available. If the 1H-jumper is closed and no command is received within 1 hour after initialisation, the watchdog will open the power relay after 1 hour of waiting. This option is very useful in cases where the operating system hangs during its startup. After 1 hour the watchdog tries to start the computer a second time by breaking the computer's power supply for a short time. This procedure repeats for further 2 times if the computer hangs permanently. If this option is enabled, the operator should take care during computer maintenance works. The computer will crash exactly one hour after booting if the operator forgets to send the STOP-command to the watchdog!



**Figure 2** Location of the 1H-Jumper

## Serial Watchdog

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After the computer has finished its startup procedure, the watchdog program sends the START-command to the watchdog. Now the watchdog is reactivated. It sets the COMMUNICATION-LED and the STATE-OF-HEALTH-LED flushes red. The watchdog waits 30 seconds for a PING-command. If it receives a ping, it clears all timers and starts waiting again, independent of the parameter. If the ping does not appear within 30 seconds, the watchdog generates a periodical acoustic signal, if audible alarm is enabled, which indicates that the power relay will be opened in 5 minutes and sets the STATE-OF-HEALTH-LED to red. This process can be stopped by sending the STOP-command.

If the watchdog receives a ping during this phase, it sets the STATE-OF-HEALTH-LED and the acoustic signal according to table 1 and clears all timers. Now it waits exactly 30 seconds for the next ping (see above).

If no ping is received within 5 minutes after the STATE-OF-HEALTH-LED has changed to red, the watchdog generates a continuous acoustic signal (if enabled) and opens the power relay for exactly 40s. During this time it does not accept any commands. After these 40 seconds the watchdog runs its initialization procedure as described above.

The STOP-command works everytime unless the power relay is open. It clears the COMMUNICATION-LED, sets the STATE-OF-HEALTH-LED to red and disables all timers including the 1H-timer. Only the next START-command will activate the watchdog again.

Table 1: Watchdog behaviour on different commands

Command	Parameter	STATE-OF-HEALTH-LED	acoustic signal <sup>(1)</sup>
START	xxh	red flushing	off
STOP	xxh	red	off
PING	00h	green	off
PING	01h	red flushing	off
PING	02h	red	5 sec. every hour

<sup>(1)</sup> if enabled

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### 3 Optional Features

The standard version of the Serial Watchdog includes all features described above. Only these ones are currently available. The hardware itself is prepared to very easily add some features in the future by merely changing the firmware of the watchdog.

In the watchdog standard version all time presets are fixed (e.g. the power-off time). The customer is not able to change them. On the watchdog's electronic board three PCB code switches are placed. They are without function. These code switches can be used to make some time presets changeable by the customer.

Furthermore the Serial Watchdog contains a real time clock and an EEPROM. With this combination it would be possible to record some special events like missing pings with time stamps. This would be very useful in cases of a total system crash (e.g. the harddisk crashes due to a power failure, no logfile available). With the stored information of the watchdog the operator would be able to analyze the crash situation.

# Serial Watchdog

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## 4 Technical Data

### 4.1 Hardware Specification

#### *Power Supply*

Operating voltage range:	20V...28V DC (24V Version) 10V...15V DC (12V Version)
Power consumption:	50mA @ 24V max. 110mA @ 12V max.

*State-Of-Health Relay characteristics:* 48V; 6A

*Power Relay characteristics:* 250V AC; 5A

#### *Time Presets*

Ping Time:	30s
Wait-Time:	5min
Power-Off Time:	40s
1H Time:	60min

*Operating Temperature Range:* 0 °C ... 50 °C

#### *Dimensions:*

Width:	45mm
Depth:	109.5mm
Height:	75mm

*Weight:* 210g

*Protection Class:* IP42

## 4.2 Software Specification

<i>Preset Watchdog Time:</i>	30...36000s; changeable in steps of 30s
<i>Possible Communication Ports:</i>	COM1...COM8
<i>Monitored Event:</i>	writing files into a specified (monitored) directory
<i>Monitored Directory:</i>	free selectable, can be everyone from a local harddisk; all sub-directories are also monitored (optional)
<i>Logfile:</i>	<i>monitored_dir</i> \ <b>watchdog.log</b> filename and location are fix
<i>Action if monitored event does not appear during the Preset Watchdog Time:</i>	<i>forced Windows Shutdown</i>

# Serial Watchdog

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## 4.3 Command Set Summary

Communication is always initialized by the host computer, the watchdog itself does not start requests. Each time the computer sends a command to the watchdog, it will send an answer back. Commands and answers always consist of 4 bytes. The first byte represents the checksum of the following 3 bytes and the second byte is interpreted as command itself. The last two bytes are ignored or interpreted as parameter / data. If the watchdog is able to interpret the command, it sends the last 3 bytes of the command with a new calculated checksum as answer back to the host. If the watchdog receives an unknown or faulty command, it sends a 4 byte long error code back. The first byte of this code represents the checksum and the second byte is always FFh. The third byte represents an error identifier and the fourth byte contains a more detailed error code.

### Command Set

Command / Answer	Byte1	Byte2	Byte3	Byte4
START	CC <sup>3</sup>	00h	xxh	xxh
	CC <sup>3</sup>	00h	xxh	xxh
STOP	CC <sup>3</sup>	01h	xxh	xxh
	CC <sup>3</sup>	01h	xxh	xxh
PING	CC <sup>3</sup>	02h	PNG <sup>6</sup>	xxh
	CC <sup>3</sup>	02h	PNG <sup>6</sup>	xxh
VERSION	CC <sup>3</sup>	03h	xxh	xxh
	CC <sup>3</sup>	03h	HW <sup>1</sup>	FW <sup>2</sup>
GET_OPTIONS	CC <sup>3</sup>	04h	xxh	xxh
	CC <sup>3</sup>	04h	00h	OPT <sup>5</sup>
SET_OPTIONS	CC <sup>3</sup>	05h	xxh	OPT <sup>5</sup>
	CC <sup>3</sup>	05h	xxh	OPT <sup>5</sup>

<sup>1</sup> Hardware-Version

<sup>2</sup> Firmware-Version

<sup>3</sup> checksum;  $CC = (\text{Byte2} + \text{Byte3} + \text{Byte4} + 2Ah) \text{ MOD } FFh$

<sup>5</sup> OPT = Option Register; 00h = audible alarm enabled

08h = audible alarm disabled

<sup>6</sup> PNG = PING-qualifier; 00h = everything works perfectly

01h = the watchdog program works perfectly but the state of the main application is unknown

02h = watchdog program has stopped soft-restarts but continues to observe the main application



### Errorcodes

Error	Byte1	Byte2	Byte3	Byte4
HARDWARE ERROR	CC <sup>*3</sup>	FFh	00h	RCSTA <sup>*4</sup>
UNKNOWN COMMAND	CC <sup>*3</sup>	FFh	01h	00h
CHECKSUM ERROR	CC <sup>*3</sup>	FFh	06h	CALCC <sup>*5</sup>
EEDATA ERROR	CC <sup>*3</sup>	FFh	07h	00h

\*4 RCSTA corresponds to PIC-Register

\*5 checksum from firmware calculated

## 4.4 History

### Hardware

HW	Description
0x10	initial Version

### Firmware

FW	Description
0x10	initial Version
0x11	<ul style="list-style-type: none"> <li>- Number of restarts changeable</li> <li>- Audiable Alarm changeable</li> <li>- STOH LED is now red flashing after a start command instead of continously green shining</li> <li>- second kind of PING implemented (option 0x01)</li> </ul>

# Serial Watchdog

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## 5 EC Comformity declaration

Herewith we declare that the design of the device described below is in accordance with the mentioned EC regulations. This declaration loses its validity by unauthorized changes.

<i>Description:</i>	serial controlled watchdog for unattended computer systems
<i>Type:</i>	Serial Watchdog, Standard Version
<i>Year of manufacture:</i>	2001
<i>Applicable EC rules:</i>	73/23/EWG (Niederspannungsrichtlinie)
<i>changed by:</i>	93/68/EWG
<i>changed by:</i>	89/336/EWG (Elektromagnetische Verträglichkeit)
<i>changed by:</i>	91/263/EWG; 92/31/EWG; 93/68/EWG
<i>Applied harmonized Norms:</i>	EN 50081-1 EN 50082-1 EN 61010 / VDE 0411

The design was tested according to the given norms and standards.

Rossendorf, January 2001

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