# **Operating Instructions**

Dulcodes UV Disinfection System





Please affix nameplate here!

Please read the Operating Instructions through completely before commissioning this equipment. Do not discard! Any part which has been subject to misuse is excluded from the warranty!

## **General Information for Users**

This operating instructions manual contains the product descriptions in the main text.

- main points,
- ➤ instructions

and safety information are indicated by pictograms:

## Danger!

Ignoring safety information can endanger life or result in serious injury!

#### Caution!

Ignoring safety information can result in injury to persons or damage to machinery or other materials!



## Warning!

Note!

Ignoring safety information can result in damage to machinery or other materials!



Special Guidelines



#### Important!

Working guidelines.

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Subject to technical alterations.

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We,	EC Declaration of Conformity ProMinent Dosiertechnik GmbH m Schuhmachergewann 5 - 11 D - 69123 Heidelberg
hereby declare that, on the basis of it circulation by us, the product specifie and health stipulations laid down by E Any modification to the product not ap	s functional concept and design and in the version brought into d in the following complies with the relevant, fundamental safety EC regulations. oproved by us will invalidate this declaration.
Product description :	disinfection plant Dulcodes and Dulcodes compact
Product type :	UVCa
Serial number :	see type identification plate on device
Relevant EC regulations :	EC - machine regulation (98/37/EEC) EC - low voltage regulation (73/23/EEC) EC - EMC - regulation (89/336/EEC subsequently 92/31 EEC)
Harmonised standards used, in particular :	DIN EN 292-1, DIN EN 292-2 DIN EN 60204-1, DIN EN 60335-1, DIN EN 50106 DIN EN 50081-1/2, DIN EN 50082-1/2 DIN EN 61000-3-2, DIN EN 61000-4-2/4/5
National standards and other technical specifications used, in particular :	
Date/manufacturer's signature :	December 23, 1999
The undersigned :	Dr. Rainer V. Dulger, Executive Vice President R&D and Production

#### 1 Use

The Dulcodes UV disinfection system is used for the disinfection of

- · drinking water
- · industrial water and
- waste water.

In UV disinfection, the water to be disinfected is exposed to short wave UV light. This UV-C radiation is a quick and effective germicide.

The Dulcodes UV disinfection systems are supplied fully wired.

They are available in a range of design options, each of which is characterised by an identity code. Technical ratings are given in the data sheet accompanying each Dulcodes UV disinfection system.

Included in standard delivery

- radiation chamber
- lamp/s with corresponding lamp protection tube/s
- control cabinet containing electronic ballasts
- system controller
- UV-C sensor
- operating instructions manual and data sheet

## 2 Safety Guidelines

#### Danger!

- UV-C radiation is hazardous to eyes and skin! Switch on lamps only when they are correctly installed! Prior to switch on lamps ensure UV disinfection system has been correctly installed!
- The sensor can operate properly only when it has been correctly calibrated. Water disinfection will be inadequate if the sensor cannot detect conditions correctly.
- When using in critical disinfection applications (e.g. drinking water disinfection) ensure all pipework downstream from the system has been thoroughly disinfected, e.g. high chlorination. This is vital for pipework which has become micro-biologically contaminated.
- Ensure that the water flow remains within the maximum and minimum permissible range. Disinfection cannot be guaranteed otherwise!
- When UV disinfection systems operate for a long period without a through-flow of water, especially in large systems, monitor the water temperature and shut down system if necessary!
- The system should be located in a dry, frost proof area. It must be protected against chemicals, dyes and fumes.
- The ambient temperature and the re-radiation temperature in the immediate vicinity must not exceed 40 °C!
- If the water to be disinfected contains suspended or dissolved solids, a suitable filter must be installed upstream from the disinfection system.
- Ensure that the maximum permissible operating pressure given in the accompanying data sheet is not exceeded!
- Prior to installation of the lamps switch off power using the main switch or remove mains plug!
- Do not switch on the system until the radiation chamber is full of water!
- Check that the UV lamps are operating on standard current!

## (!) Important!

Read the data sheet which accompanies each UV disinfection system! Under specialised conditions requiring that the sensor signal is displayed in W/m<sup>2</sup>, follow the additional instructions manual supplied!

	3 Function
	The water to be disinfected flows through the stainless steel chamber along the UV lamps. The UV radiation effectively eliminates micro-organisms.
	The low pressure lamps used in the system emit a high yield UV-C radiation with wave length 254 nm. This is particularly effective for disinfection purposes. The lamps are located in lamp protection tubes made from high grade quartz which allow a maximum of radiation to pass through.
	The compact design of the radiation chamber, the optimised flow inlet and integrated turbulence control mean that the entire water flow is subjected to even radiation.
	A controller combined with the UV-C sensor monitors the UV disinfection system. In larger systems the controller is housed in a control cabinet, and in smaller systems it is mounted onto a backboard with the electronic ballast.
Commissioning	When Dulcodes UV disinfection system is switched on, the lamps are activated. In multi-lamp systems electronic ballasts connected via a data bus are activated before the lamps are ignited. Depending upon the size of the system this can result in a few seconds delay. After ignition the lamps take several minutes to reach operating temperature.
	The UV-C sensor monitors the lamps. As soon as the UV-C output has crossed the safety threshold the rinse valve opens for start rinse.
	The rinse valve will open even if the safety threshold is not reached within the maximum permissible warm-up phase. If the safety threshold is not reached, even within the maximum free rinse phase, the controller will shut down the UV disinfection system and move into fault mode.
	After the start rinse the stop valve opens. The UV disinfection system is now in normal operating mode.
Normal operation	In normal operating mode the UV-C sensor continues to monitor the UV-C output:
	If UV-C output falls below the minimum warning threshold: a warning is indicated.
	If UV-C output falls below the minimum safety threshold: the stop valve closes and the rinse valve opens. If the safety threshold is not exceeded within the maximum free rinse phase the controller shuts down the UV disinfection system and a fault is indicated.
	All lamps are monitored. If a lamp fails the stop valve closes, the controller shuts down the UV disinfection system and a fault is indicated.
Auto Rinse	Activating auto rinse causes the rinse valve to open automatically for a preset period once a maximum standing period has elapsed.
Shut down	When the UV disinfection system is switched off, the stop valve closes and the lamps are switched off. If lamp post-burn is necessary, the lamps remain on until the lamp post-burn phase has elapsed.
	4 Controller

Version As electronics and software are constantly being upgraded, the version number is supplied as a means of identification. Please supply this when making any claims to the supplier. It may be called up on the display.

*Factory Settings* The Dulcodes UV disinfection system controller is pre-configured in the factory before delivery. For most applications there is no need to adjust the settings, except for sensor calibration.

#### Important!

(!)

Settings can only be changed when the UV disinfection system is switched off, with the exception of sensor calibration and adjustment of lamp current.

## 4.1 Display

The system has a graphic display.

In operating mode

Display of operating state Warnings are indicated by flashing arrows and text messages, faults are indicated by flashing fault messages.

In programming mode



Flashing text indicates numerical values or parameters which can be changed or entered.

#### Important!

5 minutes after the last keystroke the display returns to the normal display of current operating state.



## 4.2 Function Keys



Hold START/STOP key down for at least 2 seconds. 5 minutes after the last keystroke the display returns to the normal display of current operating condition.



## 4.3 Operating State Display and Parameter Settings



Α

#### Programming instructions



Important!

1

Once the access code is correctly entered it is not necessary to re-enter the access code for subsequent programming. When ENTER key is pressed the flashing values/settings appear immediately.

Access is automatically triggered 5 minutes after the last key operation/after return to the trend or standard displays.

## 4.3.1 Trend Display



The trend display shows lamp ageing, deposition on lamp protection tubes or changes in the water quality

The progress of the UV sensor signal is shown in a time window. Horizontal lines indicate the current safety threshold and the alarm threshold. The short vertical strokes show when UV disinfection system has been switched on/off. The display range of the UV sensor signal falls between 0 % (and/or W/m<sup>2</sup>) and the value allocated to the 20 mA analogue output (see 4.3.11). The time window is adjustable (see 4.3.8) and provides a dynamic display: after the selected time has elapsed, the most recent value appears, and the least recent value disappears.



#### Important!

Each calibration of UV-C sensor is recorded in the trend display by a vertical line from the bottom to the top of the window.

1

#### Important!

The contents of the trend display are deleted on changing the display range and on resetting the lamp hours counter.

Factory settings

## Time window:100 daysMaximum value of sensor signal:120 %

## 4.3.2 Changing Access Code

To prevent unauthorised changes to the settings the system controller will only access to the programming mode only when an access code is entered. The access code can be set by the operator. Programming mode is locked each time the access code is changed. The lock is released only once the new access code has been entered.





#### Important!

5000

Write down the access code! Parameter settings can only be changed when the correct access code is entered.

The factory-set access code does not guarantee against unauthorised changes.

Factory setting

## 4.3.3 Setting Language



Toggle between the different languages: German, English, French, Spanish

Factory setting German

## 4.3.4 Activating/Deactivating Electronic Ballast Bus

The electronic ballast for the High Flux lamps (e.g. 80-W-lamps, 130-W-lamps, 230-W-lamps) operates via a bus interface. The bus interface turns lamps on and off and monitors for lamp failure. Lamp current can also be changed. With the bus active and the system switched on, the number of ballasts is indicated. The identcode of the individual ballasts can be displayed by pressing the UP and DOWN keys.



#### Important!

In UV disinfection systems whose electronic ballasts are connected via a bus interface, switch bus to active. Lamps cannot be switched on when bus is passive.

Factory setting Systems with bus interface, active. Others, passive.

## 4.3.5 Setting Lamp Current

Lamp current = 2 A	
(min. 1.2 A) (max. 2.3 A)	

In systems with electronic ballasts connected via a bus interface, the lamp current may be adjusted within a certain range. Lamps can therefore be adapted to suit different operating conditions.

The lamp current is also adjustable in operating and free-rinse modes.

The max./min. values for lamp current are not monitored when the system is turned off. If a value outside the permissible range is set then the fault message: "lamp current" will appear when the system is switched on.

#### Important!

Lamps should operate on standard current except for a few exceptional cases. Please find the permissible lamp current range and standard current on accompanying data sheet. Two standard currents are given for UV disinfection systems which are also equipped for hot water disinfection: one for hot and one for cold water applications.



1

#### Warning!

2 A

Premature failure can result when lamps are operated on currents outside permissible range:

- Excess lamp current leads to overheating of lamps and a decrease in UV-C output.
- Too low current to lamps can lead to a significant reduction of UV-C output.

Water temperatures < 8 °C

End of operating life

For lamps at the end of their operating life an increase of the lamp current: 0.2 to 0.4 A above standard current can increase UV-C output slightly.

If UV lamps show a slight decrease in UV output when water temperatures are < 8 °C, a slight

increase in the lamp current: 0.1 to 0.3 A above standard current can increase UV output.

Factory setting

## 4.3.6 Sensor Signal Display

Sensor signal displayed	
in: %	

The UV-C sensor monitors the UV-C output.

A drop in the sensor signal can be caused by

- · deposition on lamp protection tubes
- significant worsening of UV transmission in water
- decrease in UV-C output in lamp due to lamp ageing

Toggle between a relative display of sensor signal in % and an absolute display in W/m<sup>2</sup>.



%

#### Important!

The correct sensor signal is displayed after calibration. The sensor signal is generally given in %. In special applications, requiring display of sensor signal in W/m<sup>2</sup>, follow instructions in accompanying operating instructions.

Factory setting

**ProMinent**<sup>®</sup>

## 4.3.7 Sensor Calibration

108 %
Cal. factor =
0.420
Time 5:00

It is necessary to calibrate the sensor during commissioning and also whenever a lamp is replaced (see 6.3).

#### Important!

The sensor can be calibrated only while the system is running. If the sensor signal is too low for correct calibration, a flashing double arrow will appear instead of the sensor signal display in % and/or W/m<sup>2</sup>. Calibration is locked in these circumstances. During calibration the alarm and safety thresholds are not monitored.



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#### Warning!

Sensors can operate properly only when they have been correctly calibrated. Water disinfection will be inadequate if sensors cannot detect conditions correctly.

## 4.3.8 Setting Display Range in Trend Display

**Display range** trend display

100 day

The sensor signals can be tracked via a time window in the trend display. This window can be adjusted to increase or decrease the length of time (value in days) displayed. After the selected time has elapsed, the most recent value appears, and the least recent value disappears.

Factory setting 100 days

## 4.3.9 Setting Safety Threshold

50 %	
Safety threshold	

If UV output drops far enough, the sensor signal will fall below the safety threshold. Safe disinfection is no longer guaranteed. This is indicated on the screen by two flashing arrows.

The safety threshold is usually set at 50 %. This can be altered for specialised applications.

An alarm can be connected to the SAFETY THRESHOLD fault relay on the controller. Relay closes when signal falls below safety threshold.

Factory setting



#### Warnina!

Effective disinfection can be achieved only when safety threshold has been correctly set.



#### Important!

The safety threshold must be lower than the warning threshold. It cannot be set higher than the alarm threshold.

In special applications, requiring display of sensor signal in W/m<sup>2</sup>, follow instructions in accompanying operating instructions.

## 4.3.10 Setting Warning Threshold

60 %	
Warning threshold	

If UV output drops far enough, and the sensor signal falls below the warning threshold, a warning is registered. To avoid signal falling below safety threshold, carry out immediate cleaning of lamp protection tubes or replace lamps and/or improve water quality with suitable pre-treatment. A flashing arrow on the screen indicates that warning threshold has been undershot.

An alarm can be connected to the fault indicating relay WARNING THRESHOLD on the controller. Relay closes when warning threshold is undershot.

The warning threshold is usually set to 60 %. This can be altered for specialised applications.

Factory setting



#### Important!

60 %

The warning threshold must be higher than the safety threshold. It is not possible to set the warning threshold below the safety threshold. In special applications, requiring display of sensor signal in W/m<sup>2</sup>, follow instructions in accompanying operating instructions.

## 4.3.11 Analog Output Sensor Signal: Allocating Standard Signal

```
Analog output
0 % = 0 mA
120 % = 20 mA
```

The UV-C sensor signals can be printed out for log purposes if required. Connect graphical recorder to the standard signal output.

Select a standard signal of either 0 to 20 mA and 4 to 20 mA: 0 or 4 mA corresponds to sensor signal 0 % (W/m<sup>2</sup>), any value can be allocated to 20 mA.



#### Important!

The sensor signal allocated to 20 mA is also the maximum value of trend display.

Factory setting

0 % = 0 mA 120 % = 20 mA

#### 4.3.12 Activating pump controller

Pump control	
On	

You need to activate the pump controller to control a booster pump with the pump relay.

The pump relay opens when the system is switched off and if the pump controller is off, it remains open once the system is running again.

If the system is switched on when the pump controller is on, the system exits warm-up mode once values exceed the warning threshold. The pump relay then closes.

If the system is switched off or is switched to pause mode, the pump relay opens.

If values fall below the safety threshold during operation, or if a lamp fails, the pump relay opens and the system switches to fault mode.

Factory setting



#### Warning!

Off

The UV disinfection system may only be operating when the radiation chamber is full of water. If the radiation chamber is empty or only partly full there is a danger of damage to lamps and radiation chamber. Therefore, ensure that the radiation chamber cannot run dry while the pump is switched off.



#### Important!

Commissioning, free and intermittent flushing are not possible when the pump controller is on, the relevant programming windows are therefore concealed.

#### ) Important!

Since the booster pump generally has a specified run-off, the lamp after-burn period for applications requiring a high rate of disinfection reliability should usually be set to 1 minute.

#### 4.3.13 Setting Start Rinse Duration

Start rinse duration	
1 min	

The start rinse should be long enough to ensure that only pure water reaches the consumer. As soon as the UV lamp has reached the operating temperature after ignition, and the sensor signal is higher than the safety threshold, the rinse valve opens (if fitted) to allow start rinse. The stop valve opens next.



#### Important!

1 min

In most cases a start rinse of 1 min is sufficient. If there is no rinse valve fitted the start rinse can be set to 0 min.

Factory setting

#### 4.3.14 Setting Maximum Free Rinse Duration

Max. free rinse duration

00:01 h:min

The free rinse is generally used in the disinfection of drinking water, where maximum free rinse is often set to more than 10 hours. When, for instance, heavy rain has fallen, and water passes through little natural filtration, transmission can deteriorate to the point where the UV-C signal falls below the safety threshold. The stop valve then closes and the rinse valve opens. Once the water quality has improved sufficiently, the UV disinfection system returns to normal operation. If the UV-C sensor signal does not cross the safety threshold within the maximum free rinse duration the UV system goes into fault mode.

Factory setting 1 min

## 4.3.15 Lamp Post-Burn

Lamp postburning	
off	

In some circumstances in large UV systems for drinking water disinfection a period of time elapses before the stop valve closes, or the water flow is halted in some other way. In such cases lamp after-burn prevents water which has been insufficiently disinfected from reaching the consumer. In most cases an after-burn phase of 1 min is sufficient.

Factory setting

off

## 4.3.16 Setting Automatic Rinse in Intervals

Maximum off-time
00:00 h:min

Auto rinse duration 0 min

Automatic rinse in intervals generally applies to domestic drinking water systems. In such systems, there are often long periods when no water is extracted. Rinsing during these periods helps prevent water from heating up and becoming over-radiated.

A flow monitor is connected to the FLOW input on the controller. This closes when a minimum flow threshold is exceeded. The rinse valve opens for the rinse period if no water has been extracted during the maximum off-time.

Alternatively, if there is no flow monitor connected to the FLOW input, the rinse valve then opens for the automatic rinse period after the maximum off-time has elapsed (auto. rinse).

In most cases the maximum off-time is set to 5 hours, and a period of 1 min is generally sufficient.

There will be no automatic rinse if the maximum standing period is set to 00:00.

Factory setting 00:00 h:min

4.3.17 Setting Minimum Line Voltage

Minimum line voltage	
180 V	

Monitoring line voltage prevents UV system failure due to insufficient voltage. If the line voltage drops below a minimum value the system will shut down. If the line voltage rises above the minimum value once more, the system automatically recommences normal operation.



#### Warning!

180 V

Do not alter minimum voltage without consulting your nearest customer services department.

Factory setting

## 4.3.18 Pause Function

Pause on pause contact	
Closed	

The UV system can be turned on and off via open/closed external contacts connected to the break input on the controller.

Select whether the UV system is activated by an open or a closed contact.

Factory setting Pause on pause contact closed, UV system operates when contact opens.

## 4.3.19 Display/Reset Counters

Operat. hours.	Lamp hours.
400 h	400 h
turn-ons	Lamp turn-ons
25	25

The OPERAT. HOURS and TURN-ONS counters cannot be reset. The LAMP HOURS and LAMP TURN-ONS can be reset.

## 4.3.20 System Response to Faults

Behave at fault	
System off	

In the event of a fault, the UV disinfection system is normally switched off. In some non-standard applications, however, it may be sensible to run the system at reduced power (emergency operating mode).

## Warning!

- The disinfection power of the UV system is greatly reduced in emergency operating mode.
- Emergency operating mode is not permitted for applications requiring a high rate of disinfection reliability, e.g. drinking water disinfection.
- The system power is significantly reduced in applications where emergency operating mode of the UV system is admissible.
- In emergency operating mode a stop valve (if present) opens immediately after actuating the START/STOP button, rather than after the safety threshold is exceeded. The lamps are not checked to ensure they have warned up and are delivering sufficient UV power. If necessary the water flow should be manually interrupted for 5 to 10 min after switching on emergency operating mode (manual stop valve, manual switch-off of booster pump etc.)
- The operator must check that reduced system performance cannot endanger persons or property before enabling emergency operating mode in the programming menu and before switching on emergency operating mode.
- ProMinent shall not honour guarantee claims for systems operating in emergency operating mode nor for any damage claims for resulting from operating in emergency operating mode.

A special code is required to reprogram the system response to faults. This code can only be obtained from ProMinent on request. After entering the special code the user can select emergency operating mode as the response of the system to faults.

If emergency operating mode is activated the system will signal a fault if a lamp fails or a value falls below the safety threshold after the free flushing time has elapsed. Press the CHANGE key to switch to emergency operating mode. The fault cannot now be acknowledged with the ENTER key.

Emergency operating mode can also be activated by bridging the flow circuit input. This automatically activates emergency operating mode.

In emergency operating mode the lamps are ignited, the stop valve opens and the pump rely is closed. The fault-indicating relay remains open however and lamp failure and sensor signals are no longer monitored. The WARNING AND SAFETY THRESHOLD indicating relays remain open.

## ) Important!

1

When emergency operating mode has been enabled it is impossible to operate interim flushing. The max. idle time and interval flushing time programming windows are therefore removed from the display.

Since the pump relay closes, even when the pump controller is switched off during emergency operating mode, the pump relay can be used to indicate emergency operating mode in systems whose pump controller is off. When the pump controller is switched on, it can recognize emergency operating mode because the pump relay is closed even though the fault-indicating relay is open.

## 4.3.21 Alarm Transmitting Relay

An alarm can be attached to the ALARM transmitting relay. The relay is triggered when a fault occurs, or when voltage drops.

## 4.3.22 Fault Switch Input

An external fault indicating device can be connected at the FAULT switch input, for example, a heat-sensing switch.

#### Important!

The FAULT switch input is fitted with jumpers when it is delivered. If the jumper is removed and no fault indicator is connected, the controller will register a fault and the UV system will not operate.



#### Warning!

When connecting a fault indicating device, remove the jumper, otherwise signal will not register.

#### Controller



## 5 Assembly and Installation

Please read the following safety guidelines before installing system:

## Warning!

#### Ensure that water

- · does not exceed maximum flow and
- falls within permitted UV transmission range
- otherwise adequate disinfection cannot be guaranteed!

The maximum permitted flow is given in the accompanying data sheet. It is a function of the required radiation dose and also the minimum permitted UV transmission of the water to be disinfected.

## Warning!

- The system should be located in a dry, frost proof area. It must be protected against chemicals, dyes and fumes.
- The ambient temperature and the re-radiation temperature in the immediate vicinity must not exceed 40 °C!
- If the water to be disinfected contains suspended or dissolved solids, a suitable filter must be installed upstream from the disinfection system.
- Ensure that the maximum permissible operating pressure given in the accompanying data sheet is not exceeded!

#### Important!

Even though systems are fitted with modern electronic ballasts which protect lamps during the ignition phase, avoid frequent on/off switching of the UV system.

## 5.1 Radiation Chamber

The accompanying data sheet describes radiation chamber as one of the following: *vertical wall-mounted, horizontal* or *free-standing*.

#### 5.1.1 Assembly

## Warning!

- Radiation chamber must be mounted only as shown in data sheet!
- Allow room for maintenance access! Details given in accompanying data sheet.
- *Vertical wall-mounted* > Mount radiation chamber vertically to the wall or to a suitable structure using the fixing materials supplied.

Horizontal

tal > Mount radiation chamber horizontally to the wall or to a suitable structure using the fixing materials supplied.

*Free standing* > Place radiation chamber on the floor.

## 5.1.2 Attaching the Warning Sign

## !) Important!

The inclosed self-adhesive warning sign should be attached such that it is well visible on the radiation chamber.

## 5.1.3 Hydraulic Connections

#### Warning!

- Observe all international guidelines and national regulations when carrying out hydraulic connections.
- Use UV-resistant material for all hydraulic connections!
   PVC will fade at connection points, and will become brittle under certain conditions.
- When used in critical disinfection applications (e.g. drinking water disinfection): Fit an automatic stop valve downstream from the radiation chamber and connect to controller! The automatic stop valve must be self operating so that water flow is halted in the event of power failure.

#### (!) Important!

- Fit stop valves up- and downstream from the radiation chamber to enable maintenance work to be carried out.
- Fit flamable taps up- and downstream from the radiation chamber for micro-biological sampling.

## 5.2 Control Cabinet and Controller

#### 5.2.1 Assembly

Mount control cabinet or backboard with controller and electronic ballast to wall or suitable structure. The lamp and the sensor should be connected using the cables supplied.

#### Warning!

The lamp connection cable and the sensor cable must not be lengthened!

## 5.2.2 Electrical Connectors

The electrical installation must be carried out by an authorised electronic engineer, and according to electrical diagrams provided.

## Warning!

- Observe all international guidelines and national installation regulations!
- Only carry out electrical work when machine is disconnected from the power.
- Connect earth lead to radiation chamber!
- Do not lengthen lamp connection cable and the sensor cable!

## 5.2.3 Opening Controller

It is only necessary to open the controller if the controller is not located in a control cabinet.

#### Warning!

Disconnect from power prior to opening control cabinet!

- Remove 4 screws from upper section of housing
- ➤ Open housing:
  - place the forefinger on the front edge of the housing and exert pressure and ease forward: this releases the catches
- ► Gently pull the top section forward and away from the lower part
  - (they are connected with a flat cable!)
- Lift up the upper section carefully approx. 80 mm with both guide-rails.

Now all electrical terminals are accessible. There are closed cable apertures on the underside of the controller. Break these open in order to insert connection cables.

The back row of apertures are for PG-11 threaded connectors.

The 5 apertures in the front row are for PG-7 threaded connectors.





#### Warning!

Use correct tool to break open cable apertures on the underside of the controller to prevent damage to the circuit boards and threads.

- > Break open cable apertures on underside of the controller
- ➤ Working on the back row first:
  - Push threaded connector, thrust collar and seal from the accompanying fixtures pack onto the cable. Screw into threaded aperture and tighten by hand.
- ► Insert cable through PG-7 threaded connectors and screw onto nut
- Connect leads to terminals as shown on electrical diagram
- Plug unused terminals to corresponding pin plugs
- ► Close controller





## 5.3 Assembly of Lamp Protection Tubes

#### Warning!

Examine lamp protection tubes for damage prior to assembly! Do not use damaged protection tubes!

- ► Remove lamp protection tube holders using key supplied
- Remove lamp protection tube holders from the radiation chamber
- > Push O-ring supplied approx. 40 mm down over the open end of lamp protection tube
- Insert lamp protection tube into radiation chamber

#### Warning!

Make sure lamp protection tube is in correct position! The lamp protection tube should protrude a maximum of 40 mm and should be not be protruding at an angle.

- Check whether the Teflon ring is fitted in the corresponding groove of the lamp protection tube holder (see Fig. 2). If not, press the Teflon ring in to lamp protection tube holder until it snaps into the groove.
- Push lamp protection tube holder over lamp protection tube. Twist and push into radiation chamber. Tighten by hand
- ► Fix lamp protection tube holder using key. Do not over-tighten.

## 5.4 Assembly and Connection of Lamp



- Switch off UV system or disconnect from power before assembly and connection of lamps!
- Only operate lamp after installation! UV-C radiation presents a hazard to eyes and skin! Install UV disinfection correctly before commissioning!
- Do not change existing lamp connection cable without authorisation!
- Do not alter distance between plug and lamp end cap. This can result in lamp not making contact with closed end of lamp protection tube. This is a prerequisite for effective disinfection!

## Warning!

Do not touch lamp glass with bare hands! Fingerprints eat into the glass and can lead to premature lamp failure. Remove fingerprints before assembly with a cloth soaked in alcohol!

- > Locate the O-ring into groove provided in the lamp protection tube holder
- ➤ Insert the lamp into the lamp protection tube leaving approx. 100 mm protruding
- Connect plug to lamp
- ➤ The plug may require 90° rotation before it locates correctly
- Insert lamp completely into lamp protection tube
- ► Fix lamp end cap using nut. Apply only light pressure

## 6 Commissioning

## Danger!

When used in critical disinfection applications (e.g. drinking water disinfection), disinfect downstream pipework e.g. by high chlorination before commissioning! This is vital for pipework which has become micro-biologically contaminated.

## 6.1 Checking Radiation Chamber Seals and Reairing Radiation Chamber

- ► Open bleed screw on radiation chamber
- ► Slowly open stop valve upstream from radiation chamber
- ► Fill radiation chamber until water leaks through bleed screw
- Close bleed screw. Apply minimum pressure
- ► Check chamber is watertight
- > Open stop valve downstream from radiation chamber (manual stop valves only)

## 6.2 Switching On Disinfection System

#### Warning!

Switch on system only when filled with water!

- > Plug in at mains and/or switch on main switch
- Check parameters in the programming menu and adjust if necessary (see 4.3 operating conditions)



#### Warning!

Check that UV lamps operate on standard current!

Switch on UV system with START/STOP key; keep key down for at least 2 seconds
 If system goes into PAUSE mode, activate pause contact

Once lamps have ignited, wait until full UV output has been reached. This can take several minutes.

As the UV-C sensor is not yet calibrated, the safety threshold may not be exceeded during the warm up phase and the maximum free rinse duration. The system will then register a fault. If this happens carry out a preliminary calibration:



#### Danger!

The preliminary calibration of the UV-C sensor must be followed by a full calibration once the system is in operation!

Preliminary calibration

Switch on system with START/STOP key

During the warm up phase calibrate the UV-C sensor as described in 6.3, to 100 %. There is, however, no need to wait until sensor value is stable.



#### Important!

In special applications, requiring display of sensor signal in  $W/m^2$ , follow instructions in accompanying operating instructions.

## 6.3 Calibrating UV-C Sensor

## Danger!

- Sensors can operate properly only when they have been correctly calibrated. Water disinfection will be inadequate if sensors cannot detect conditions correctly.
- During calibration of UV-C sensor, water must be flowing through the radiation chamber.

#### Warning!

Carry out sensor calibration each time a lamp is replaced!

Safety and warning thresholds are not monitored during calibration. For safety reasons calibration is automatically interrupted after 5 min, without changes being saved. Time remaining is shown in the display.

The sensor signal should not change again before starting calibration. A changing sensor signal indicates that the lamps have not warmed up completely (5 to 10 minutes).

Calibration 🕨 🕨

(see 4.3 and 4.3.7)

- ➤ Use CHANGE key to reach SENSOR CALIBRATION screen
- ► Use ENTER key to confirm. REQUEST ACCESS CODE screen appears
- Enter access code and confirm with ENTER key; SENSOR CALIBRATION appears once more; adjustable values flash
- Using the UP and DOWN keys, change the calibration factor until the sensor value to 100 % is indicated.
- Press ENTER to confirm. "Saving data" message appears briefly on screen. The sensor is being calibrated.
- ► Press BACK key to exit programming menu.

The Dulcodes UV disinfection system is now ready to operate.

#### !) Important!

In special applications, requiring display of sensor signal in  $W/m^2$ , follow instructions in accompanying operating instructions.

All new UV lamps require a burn-in period of 100-200 hours.

Therefore repeat the UV-C sensor calibration after 200 operating hours has elapsed.

#### 7 Maintenance

Maintenance of the UV disinfection system is limited to cleaning the lamp protection tubes and to replacing lamps at the end of their maximum permissible operating period.

For systems with a fan installed in the control cabinet, the filter mats for the fan and the fan exhaust filter should be replaced at regular intervals (usually once a year).

A daily operating log should also be kept: a pro forma sheet is included in the appendix.



- Replace the UV-C lamps after the maximum permissible operating period! The operating safety cannot otherwise be guaranteed.
- The maximum permissible operating period is included in the data sheet accompanying the UV disinfection system.
- Disconnect system from power, or switch off main switch before any maintenance work is carried out!
- Radation chamber must be pressure free before all maintenance work!
- UV-C radiation is hazardous to eyes and skin! Only operate lamps after installation! Lamps must be switched-on only when the UV disinfection system has been correctly installed!
- Clogged filter mats for the fan and the fan exhaust filter can lead to overheating and damage to the control cabinet.

## 7.1 Cleaning Lamp Protection Tubes

Deposits, e.g. iron, manganese or lime can build up on lamp protection tubes. As these deposits absorb UV-C radiation they must be removed at regular intervals.

#### **!**) Important!

Carry out cleaning when or before the sensor signal falls below the warning threshold if this decrease of the sensor signal is not caused by lamp ageing or significant decrease in UV transmission.

For many UV disinfection systems cleaning lamp protection tubes once annually is sufficient. For UV systems used to disinfect waste water cleaning may be required every two months. In multilamp systems clean all lamp protection tubes. The lamp protection tubes can be cleaned either separately from the system, or by filling the radiation chamber with a cleaning solution. Suitable solutions include dilute phosphoric acid, citric acid or dilute nitric acid.



#### Caution!

- Do not use corrosive or stress crack forming acids, e.g. hydrochloric acid!
- Read the safety data sheet for the selected cleaning solution!
- Wear appropriate protective clothing during cleaning (protective goggles, protective gloves)!
- Make sure no cleaning fluid enters the lamp protection tube!
- Take care when cleaning UV disinfection systems that no cleaning fluid enters pipework! This is particularly important for drinking water disinfection systems or similar.

## Note!

Observe relevant guidelines and regulations when using cleaning fluids!

Version1: Dismantle lamp protection tube

- ➤ Switch off UV disinfection system with START/STOP key
- Switch off main switch or disconnect from mains power
- Close stop valves up- and downstream from radiation chamber
- > Open water drainage screws and bleed screws. Empty radiation chamber
- Unfasten nuts on lamp protection tubes
- Lift lamp end cap so that the cable connection plug can be removed from the lamp
- Remove lamp completely and put to one side
- > Unfasten lamp protection tube holder with key supplied
- Twist and remove lamp protection tube from holder
- ► Lift out lamp protection tube
- ► Remove toroidal sealing ring from lamp protection tube
- Rinse lamp protection tube in cleaning fluid or dip in cleaning fluid until deposits have disappeared
- Rinse lamp protection tube in clean water and dry with a soft cloth

## $\triangle$

Examine lamp protection tube for damage prior to replacing! Do not install a damaged lamp protection tube.

- ► Examine O-ring for damage. Replace worn seal
- ➤ Insert O-ring into open end of lamp protection tube so that approx. 40 mm is protruding
- Insert lamp protection tube into radiation chamber



#### Warning!

Warning!

Make sure lamp protection tube is in correct position! The lamp protection tube should protrude a maximum of 40 mm and should be not be protruding at an angle.

- Push lamp protection tube holder over lamp protection tube. Twist and push into radiation chamber. Tighten by hand
- > Fix lamp protection tube holder using key. Do not over-tighten
- Assemble and install as described in section 5.4

*Cleaning UV-C sensor* Each time lamp protection tubes are cleaned, the UV-C sensor should also be cleaned:

#### Remove sensor cable from UV-C sensor

- ► Lift UV-C sensor out of radiation chamber
- > Clean quartz window with a cloth soaked in cleaning fluid until deposits are removed
- Rinse quartz window in clean water and dry with a soft cloth
- > Examine toroidal sealing ring for damage. Replace damaged seal
- Screw UV-C sensor back in place. Do not over-tighten
- ► Connect sensor cable to sensor
- Screw in water drainage screw and tighten. Do not over-tighten
- Slowly open stop valve upstream from the radiation chamber
- ► Fill radiation chamber until water leaks out of bleed screw
- Close bleed screw. Do not over-tighten.
- > Open stop valve downstream from radiation chamber (manual stop valves only)
- Check radiation chamber is watertight
- Plug in and/or switch on main switch

The UV disinfection system is ready to operate again.

*Version 2: Adding cleaning* Cleaning lamp protection tube by filling radiation chamber with cleaning fluid *fluid to radiation chamber* 

- ➤ Switch off UV disinfection system with START/STOP key
- Switch off main switch or disconnect from mains power
- > Close stop valves up- and downstream from radiation chamber
- > Open water drainage screws and bleed screws and remove
- ► Empty radiation chamber
- > Replace water drainage screw and tighten. Do not over-tighten.
- ► Fill radiation chamber via bleed outlet with cleaning fluid
- ► Leave for at least 20 minutes
- Open and remove water drainage screw
- > Empty radiation chamber and carefully extract cleaning fluid
- Rinse radiation chamber thoroughly with clean water until all traces of cleaning fluid have been removed
- Screw in and tighten water drainage screw. Do not over-tighten
- Slowly open stop valve upstream from radiation chamber
- > Fill radiation chamber until water leaks out of bleed screw
- ► Close bleed screw. Do not over-tighten
- > Open stop valve downstream from radiation chamber (manual stop valves only)
- Check radiation chamber is watertight
- ► Plug in and switch on main switch

The UV disinfection system is ready to operate again.

#### Important!

For radiation chambers which are regularly cleaned by filling with cleaning fluid we recommend that the water drainage screw and also the bleed screw are replaced with suitable valves. For large radiation chambers we recommend filling via the water drainage outlet with a suitable acid-resistant pump.

If the radiation chamber is filled using a pump it is wise to circulate the cleaning fluid via the bleed outlet. This reduces the cleaning time and gives better results.

## 7.2 Changing Lamps

## Warning!

The UV lamps should be replaced at the latest

- when the sensor signal nears the safety threshold if this decrease of the sensor signal is not caused by lamp ageing or significant decrease in UV transmission;
- when the lamp has been in operation for nearly or more than the maximum permissible period

Do not touch lamp glass with bare hands! Fingerprints eat into the glass and can lead to premature failure.

Remove fingerprints before assembly with a cloth soaked in alcohol!



#### Danger!

- Before assembling and installing lamps switch off system at main switch or remove mains plug!
- UV-C radiation is hazardous to eyes and skin! Only operate lamps after installation! Lamps must be switched-on only when the UV disinfection system has been correctly installed!
- Do not change existing lamp connection cable without authorisation!
- Do not alter distance between plug and lamp end cap. This can result in lamp not making contact with closed end of lamp protection tube. This is a prerequisite for effective disinfection!

## Important!

Clean lamp protection tube each time a lamp is replaced! In multi-lamp systems: if a lamp fails towards the end of the maximum lamp operating period, replace all lamps!

- Switch off UV disinfection system with START/STOP key
- Switch off main switch or disconnect from mains power
- Close stop valves up- and downstream from radiation chamber
- Unfasten nuts on lamp protection tubes by hand
- ► Lift lamp end cap so that the cable connection plug can be removed from the lamp
- Remove lamp completely and put to one side
- Check that the O-ring on the lamp protection tube holder is located correctly in the groove provided, and is not damaged. Replace damaged seal
- Insert new lamp inside lamp protection tube. Leave approx. 100 mm protruding
- ► Plug connector to lamp

1 Important!

The plug may require 90° rotation before it locates correctly.

- Insert lamp right into lamp protection tube
- Fasten lamp end cap to lamp protection tube using nut. Tighten nut by hand
- Slowly open stop valve upstream from radiation chamber
- Open stop valve downstream from radiation chamber (manual stop valves only)
- Plug in and/or switch on main switch

#### Maintenance

Resetting lamp hours and lamp turn-ons

- When system is switched off, go to lamp hours and lamp turn-ons display using CHANGE key
- ► Press ENTER key. "Request access code" appears on screen
- ► Enter access code and use enter key to confirm. "Reset" appears on screen
- > Press ENTER. The display is now reset.

#### Warning!

Re-calibrate UV-C sensor after replacing UV lamps! Safe disinfection is only guaranteed after sensor has been re-calibrated.

## 7.3 Calibrating UV-C Sensor

#### Danger!

- Sensors can operate properly only when they have been correctly calibrated. Water disinfection will be inadequate if sensors cannot detect conditions correctly.
- During calibration of UV-C sensor, water must be flowing through the radiation chamber.

Carry out UV-C sensor calibration each time a lamp is replaced!

Safety and warning thresholds are not monitored during calibration. For safety reasons calibration is automatically interrupted after 5 min, without saving changes. Time remaining is shown in the display.

The sensor signal should not change again before starting calibration. A changing sensor signal indicates that the lamps have not warmed up completely (5 to 10 minutes).

- Calibration ► ( (see 4.3, 4.3.7 and 6.3) ► (
- Use CHANGE key to reach SENSOR CALIBRATION screen
  - ➤ Use ENTER key to confirm. REQUEST ACCESS CODE screen appears
  - Enter access code and confirm with ENTER key; SENSOR CALIBRATION appears once more; adjustable values flash
  - Using the UP and DOWN keys, change the calibration factor until the sensor value to 100 % is indicated.
  - Press ENTER to confirm. "Data is being stored" message appears briefly on screen. The sensor is being calibrated.
  - ➤ Press BACK key to exit programming menu.

The Dulcodes UV disinfection system is now ready to operate.

#### (!) Important!

Special applications, requiring display of sensor signal in W/m<sup>2</sup>, follow instructions in accompanying operating instructions.

All new UV lamps require a burn-in period of 100-200 hours.

Therefore repeat the UV-C sensor calibration after 200 operating hours has elapsed.

## 7.4 Replacement of Filter Inserts

Replacement of filter inserts for the fan and the air exhaust filter



Warning!

Dirty filter inserts in the fan and the fan exhaust filter can lead to overheating and damage to the control cabinet.

The filter inserts in the fan and the fan exhaust filter should be replaced at least once a year and more frequently if ambient conditions are unfavorable.

- ► Stop the system with START/STOP key
- Switch off main switch
- Remove the fan cover by inserting fingers into the groove at the bottom edge of the cover and lifting off lid.
- > Remove dirty filter inserts and replace with new inserts, white side in (cabinet side).
- Replace the exhaust filter insert in the same way.
- Switch on main switch

#### Troubleshooting 7.5



#### Caution!

> Fault investigation requiring opening of control cabinet and exchange of components must be carried out by authorised personnel!

↓ 55 % 10 h runtime 20 turnons	Below warning threshold Indicator: Arrow down
↓↓ 40 % Free rinsing 00:11 ■■	Below safety threshold Indicator: Flashing double arrows down The remaining free rinse time is indicated (Two squares flash instead of the seconds)
Fault	Fault: Below safety threshold (after maximum free rinse period elapsed) Fault message: UV sensor
UV sensor	<ul> <li>Press ENTER to confirm fault</li> <li>Use the CHANGE key to transfer to emergency operating mode (see 4.3.20)</li> </ul>
em. serv.	<ul><li>Emergency operating mode: Lower safety threshold exceeded</li><li>System continues to run in emergency operating mode</li></ul>
UV sensor	
Possible cause Remedy Possible cause Remedy Possible cause Remedy Possible cause Remedy Possible cause Remedy	<ul> <li>Deposition on lamp protection tube</li> <li>Clean lamp protection tube</li> <li>Decrease in UV transmission of water to be disinfected</li> <li>Improve water quality</li> <li>Lamp at end of operating period</li> <li>Replace with new lamp</li> <li>Incorrect lamp current</li> <li>Operate on standard current</li> <li>Sensor incorrectly calibrated</li> <li>Re-calibrate sensor</li> </ul>
Fault	Fault: Lamp failed Fault message: Lamp xx defective
xx Lamp fail. Lamp xx	<ul> <li>Press ENTER to confirm fault</li> <li>Use the CHANGE key to transfer to emergency operating mode (see 4.3.20)</li> </ul>
em. serv.	<ul><li>Emergency operating mode: Lamp failed</li><li>Maximum performance</li></ul>
xx Lamp fail. Lamp xx	
Descible serves	Lomp vy defective

Possible cause Remedy Remedy Possible cause Remedy

Lamp xx defective ► Replace with new UV lamp Possible cause Incorrect lamp current Operate on standard current Electronic ballast defective ► Replace electronic ballast



#### Important!

➤ The number of failed lamps is indicated.

► If more than one lamps has failed, press the "Up" and "Down" keys to find out which lamps have failed.

#### Maintenance

	Indicator: Double arrows flashing on display during calibration
↓↓ Cal. factor = 0.420 Time 5:00	If flashing double arrows appear in the calibration display instead of sensor signal, the sensor signal is too small for a correct calibration. Calibration is not possible under these circumstances.
Possible cause Remedy Possible cause Remedy	Lamp protection tube and/or UV sensor are dirty ➤ Clean lamp protection tube and/or UV sensor UV sensor is defective ➤ Use new UV sensor
Fault	<ul> <li>Fault message: Other fault</li> <li>➤ Press ENTER to confirm fault</li> </ul>
Other fault	
Possible cause Remedy Possible cause Remedy	<ul> <li>External alarm triggered</li> <li>➤ Deactivate external alarm device</li> <li>No external alarm device connected and contacts on fault input not jumped</li> <li>➤ Jump contacts on fault input</li> </ul>
Fault	Fault message: Line voltage below 180 V
Line voltage below 180 V	
Cause Remedy	The line voltage is lower than the minimum permissible voltage ➤ Check line voltage
Fault	Fault message: Bus fault
Fault Bus fault	Fault message: Bus fault
Fault Bus fault Possible cause Remedy Possible cause Remedy Possible cause	<ul> <li>Fault message: Bus fault</li> <li>Break in bus connection</li> <li>➤ Restore bus connection (see "function and fault displays on electronic ballasts") Insufficient line voltage to one or more ballasts</li> <li>➤ Check line voltage and/or fuse in ballast (authorised electrical engineer only!) Electronic ballast defective</li> <li>➤ Replace ballast (authorised electrical engineer only!)</li> </ul>
Fault Bus fault Possible cause Remedy Possible cause Remedy Possible cause	<ul> <li>Fault message: Bus fault</li> <li>Break in bus connection</li> <li>&gt; Restore bus connection (see "function and fault displays on electronic ballasts") Insufficient line voltage to one or more ballasts</li> <li>&gt; Check line voltage and/or fuse in ballast (authorised electrical engineer only!) Electronic ballast defective</li> <li>&gt; Replace ballast (authorised electrical engineer only!)</li> <li>Fault message: Memory fault</li> </ul>
Fault Bus fault Possible cause Remedy Possible cause Remedy Possible cause	<ul> <li>Fault message: Bus fault</li> <li>Break in bus connection</li> <li>&gt; Restore bus connection (see "function and fault displays on electronic ballasts") Insufficient line voltage to one or more ballasts</li> <li>&gt; Check line voltage and/or fuse in ballast (authorised electrical engineer only!) Electronic ballast defective</li> <li>&gt; Replace ballast (authorised electrical engineer only!)</li> <li>Fault message: Memory fault</li> </ul>
Fault Bus fault Possible cause Remedy Possible cause Remedy Possible cause Remedy Memory fault	Fault message: Bus fault         Break in bus connection         > Restore bus connection (see "function and fault displays on electronic ballasts") Insufficient line voltage to one or more ballasts         > Check line voltage and/or fuse in ballast (authorised electrical engineer only!) Electronic ballast defective         > Replace ballast (authorised electrical engineer only!)         Fault message: Memory fault         Automatic checking by controller has revealed fault in memory         > Replace controller (authorised electrical engineer only!)
Fault Bus fault Possible cause Remedy Possible cause Remedy Possible cause Fault Memory fault Cause Remedy Fault	Fault message: Bus fault         Break in bus connection         > Restore bus connection (see "function and fault displays on electronic ballasts") Insufficient line voltage to one or more ballasts         > Check line voltage and/or fuse in ballast (authorised electrical engineer only!) Electronic ballast defective         > Replace ballast (authorised electrical engineer only!)         Fault message: Memory fault         Automatic checking by controller has revealed fault in memory         > Replace controller (authorised electrical engineer only!)         Fault message: Basic settings
Fault Bus fault Possible cause Remedy Possible cause Remedy Possible cause Fault Memory fault Cause Remedy Fault Basic setting	<ul> <li>Fault message: Bus fault</li> <li>Break in bus connection</li> <li>Restore bus connection (see "function and fault displays on electronic ballasts") Insufficient line voltage to one or more ballasts</li> <li>Check line voltage and/or fuse in ballast (authorised electrical engineer only!) Electronic ballast defective</li> <li>Replace ballast (authorised electrical engineer only!)</li> <li>Fault message: Memory fault</li> <li>Automatic checking by controller has revealed fault in memory</li> <li>Replace controller (authorised electrical engineer only!)</li> <li>Fault message: Basic settings</li> </ul>

Fault	Fault message: Lamp current
Lamp current	
Cause Remedy	Lamp current set to outside permissible range ➤ Reset lamp current to within permissible range (see data sheet)
	Function and Fault Displays on Electronic Ballasts
	Three red LED's on the electronic ballasts serve to monitor functions and investigate faults. When supply voltage is switched on, all three LED's light up for approx. 1 sec.
	"Supply voltage" LED (indicated on circuit board by term "Power")
On	Sufficient voltage to electronic ballast
Off	<ul> <li>Even though main switch is on and mains plug is in</li> <li>Check supply voltage (authorised electrical engineer only!)</li> <li>Check fuse</li> </ul>
	"Lamp" LED (indicated on circuit board by term "Fault")
Flashes for approx 1 to 15 sec	Lamp electrodes are being warmed up prior to ignition
On	Lamp not burning If supply voltage is switched on and off the LED goes out. The next time ignition is triggered, it lights up again.
	► Check lamp
	"Bus" LED (indicated on circuit board by term "Tx")
Lights up every 0.1 to 3 sec	The ballast is responding to the controller.
Does not light up	Although system is switched on: Break in the bus connection to the ballast and/or ballast is defective.
	Importanti

## (!) Important!

The data bus forms a circuit. One defective ballast and/or a break in the data line will break contact between controller and all ballasts which follow.

	Signed																			
em	Maintenance work carried out																			
tion Syst	Flow [m <sup>3</sup> /h]																			
s UV Disinfect	UV transmission [%/1 cm]																			
Log for Dulcode	Sensor signal display [%]															-				
Daily	Lamp turn-ons			i					-											
	Lamp hours																			
	Date																			
	S		T	Ī	Ì										Ī			Ī	Ī	