



Water Purification  
UVC LED Sterilizer  
Aquatech Amsterdam 2023

**Junglin Tsai**

2023.08.30

Cristal Materials Corporation





## UV-C water purification modules

To drink a glass of purified water  
Is not unreachable any more

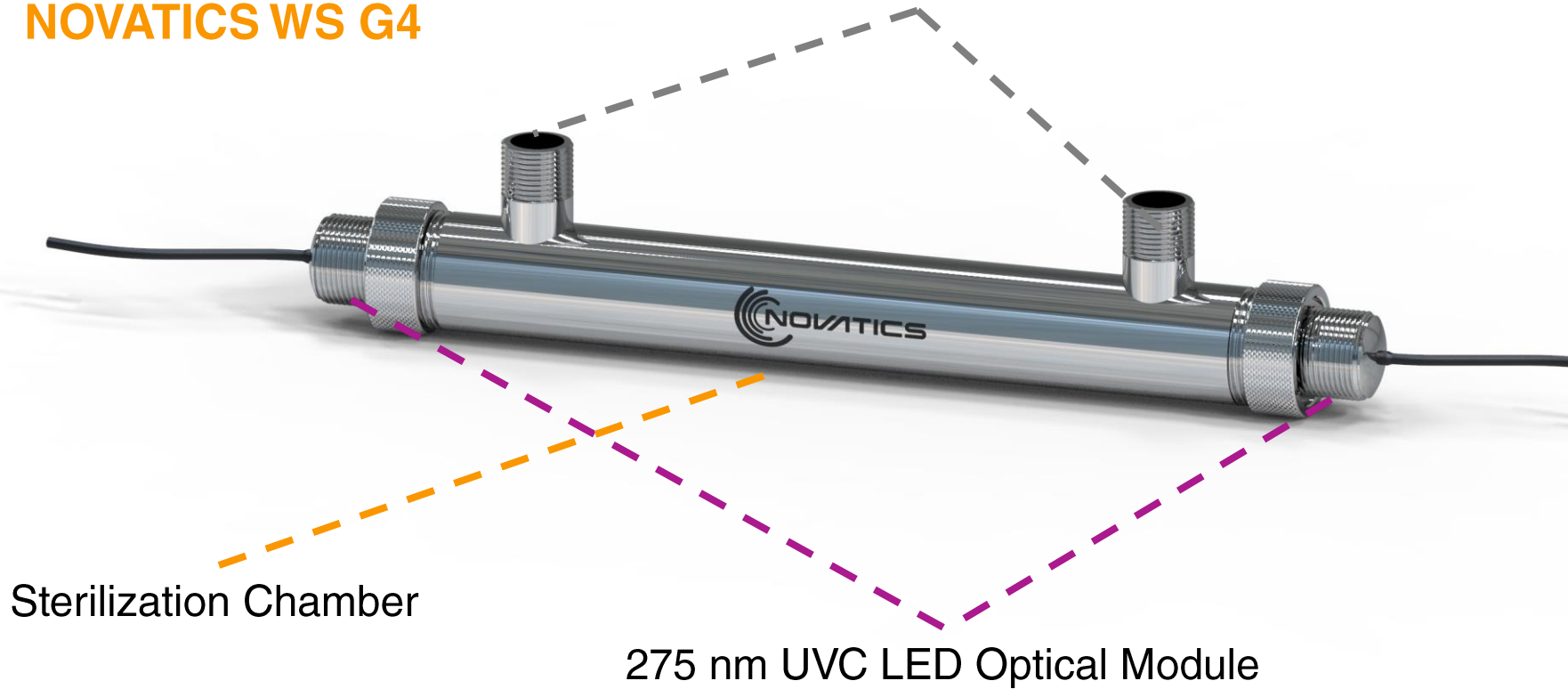


# NOVATICS WS Series

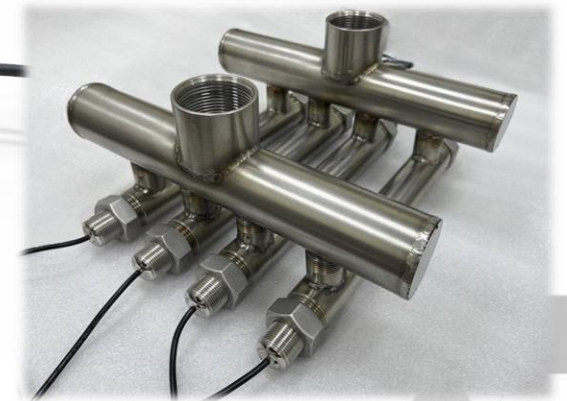


**NOVATICS WS G4**

1/2" Inlet & Outlet



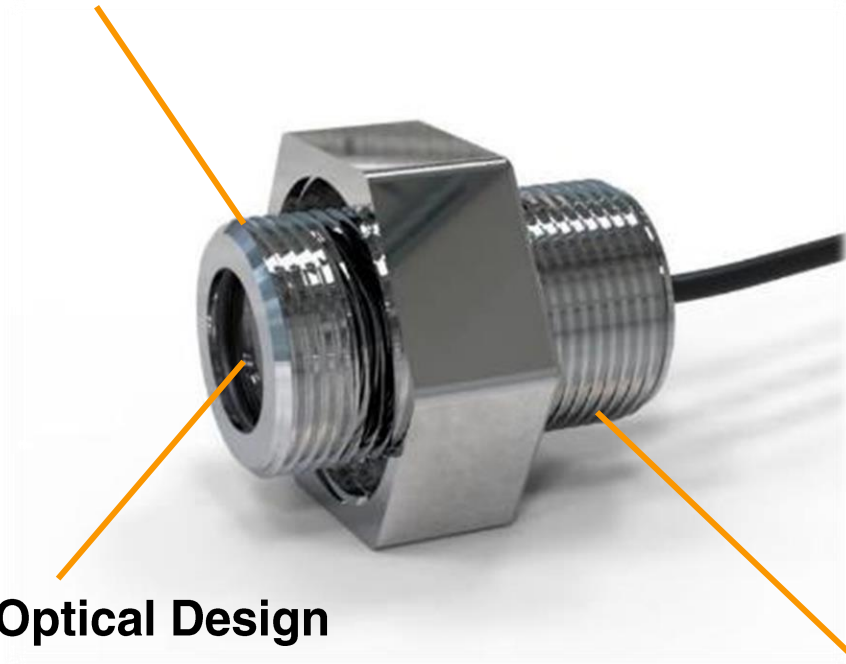
Industrial Type WS



# NOVATICS UVC LED Module



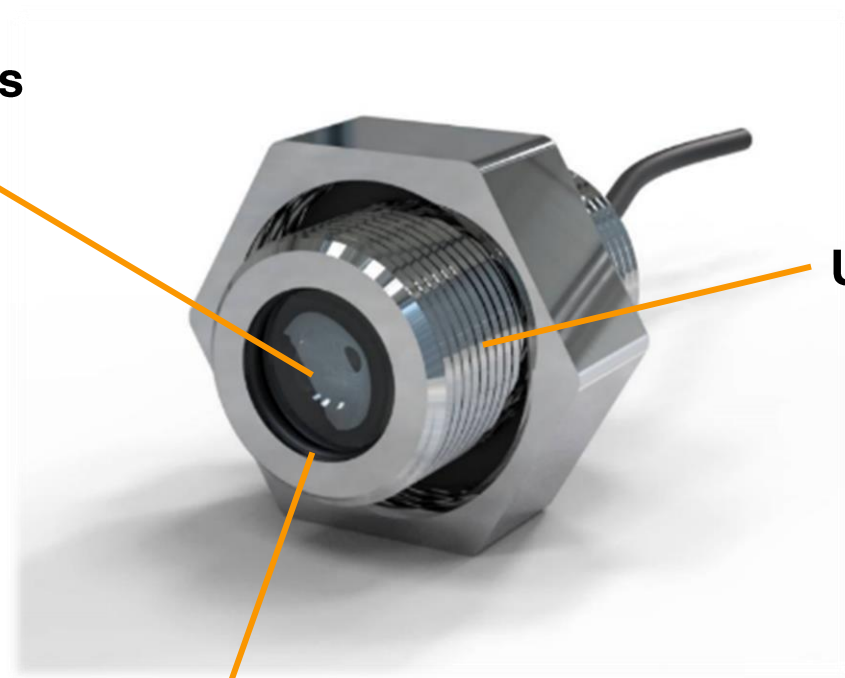
**Water Cooling System**



**Patented Optical Design**

**Food Grade SUS 316**

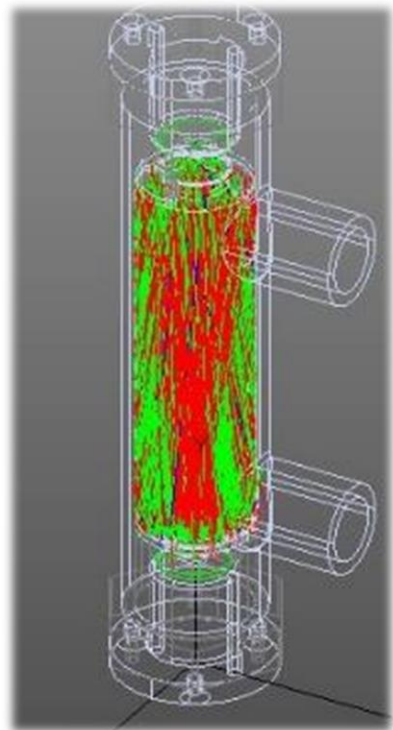
**Silica Optics**




**UVC LED**

**Water Proof Module**







## 中華民國專利證書

發明第 I761197 號

發明名稱: 紫外光陣列模組


專利權人: 晶盛材料股份有限公司

發明人: 蔡榮霖、蔡爾賢


專利權期間: 自 2022 年 4 月 11 日至 2041 年 4 月 28 日止

上開發明業經專利權人依專利法之規定取得專利權

經濟部智慧財產局局長 **洪淑敏**

中華民國 111 年 4 月 11 日 

注意: 專利權人未依法繳納年費者, 其專利權自應繳費期限屆滿後消滅。



## 中華民國專利證書

發明第 I766670 號

發明名稱: 具紫外光殺菌功能的管件模組及管件組


專利權人: 晶盛材料股份有限公司

發明人: 蔡榮霖、蔡爾賢

專利權期間: 自 2022 年 6 月 1 日至 2041 年 4 月 28 日止

上開發明業經專利權人依專利法之規定取得專利權

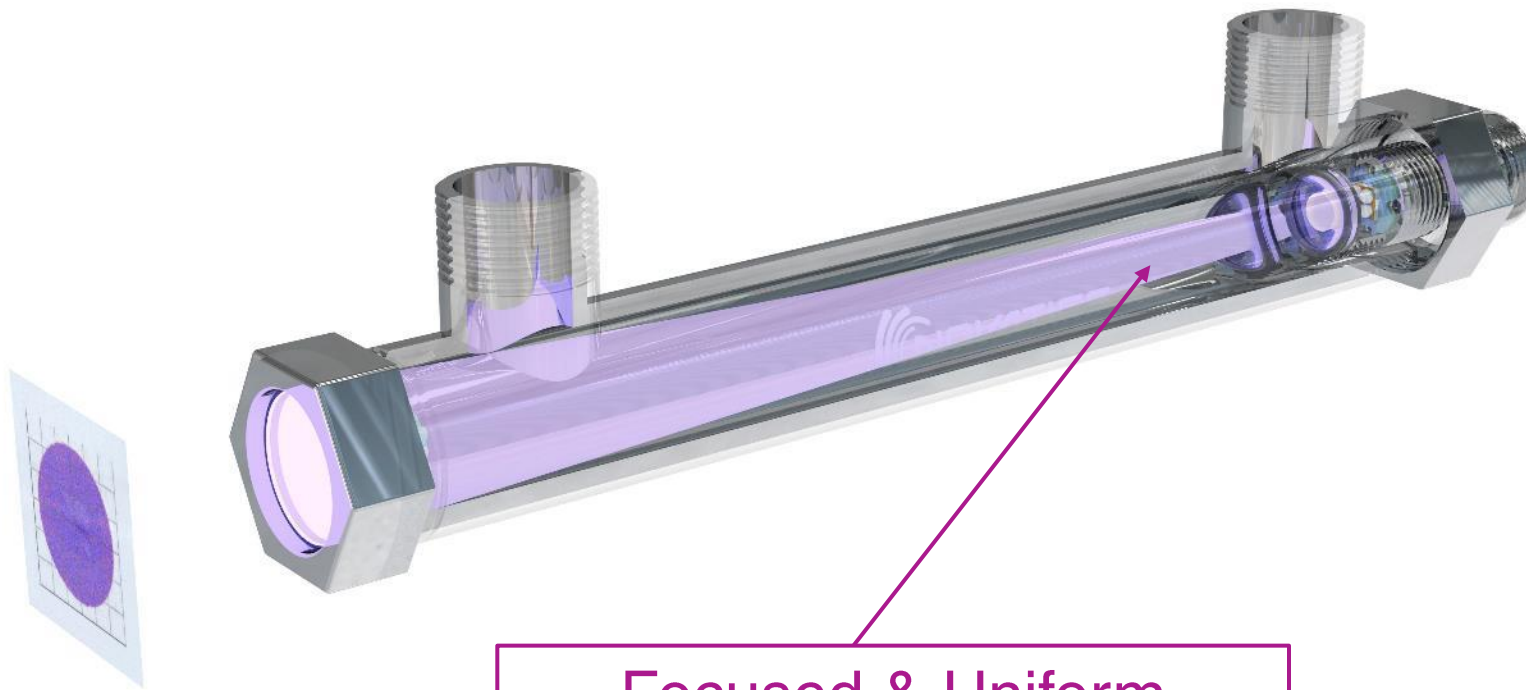
經濟部智慧財產局局長 **洪淑敏**

中華民國 111 年 6 月 1 日 

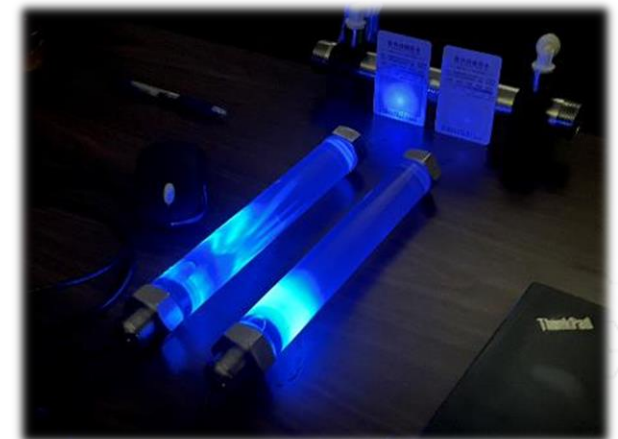
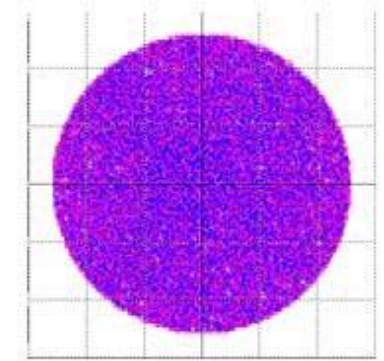
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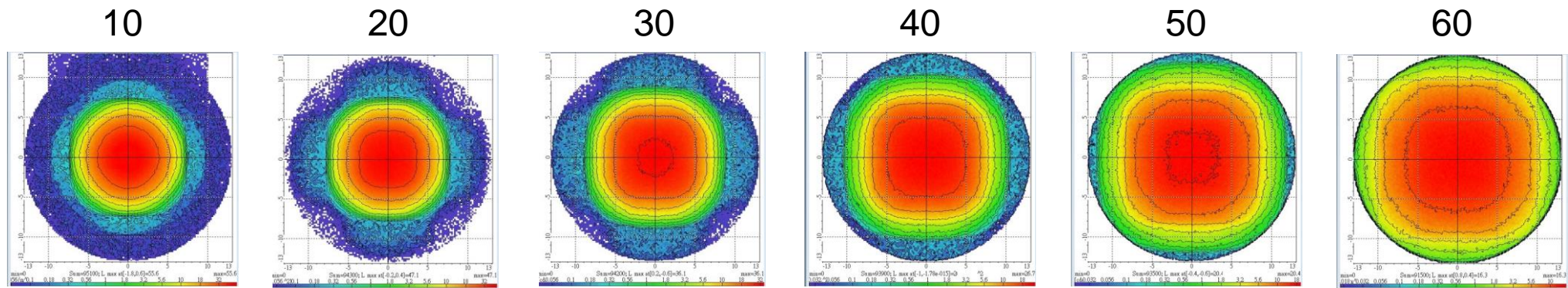
# Optimized Optical Design



Focused & Uniform  
UV-C LED Beam



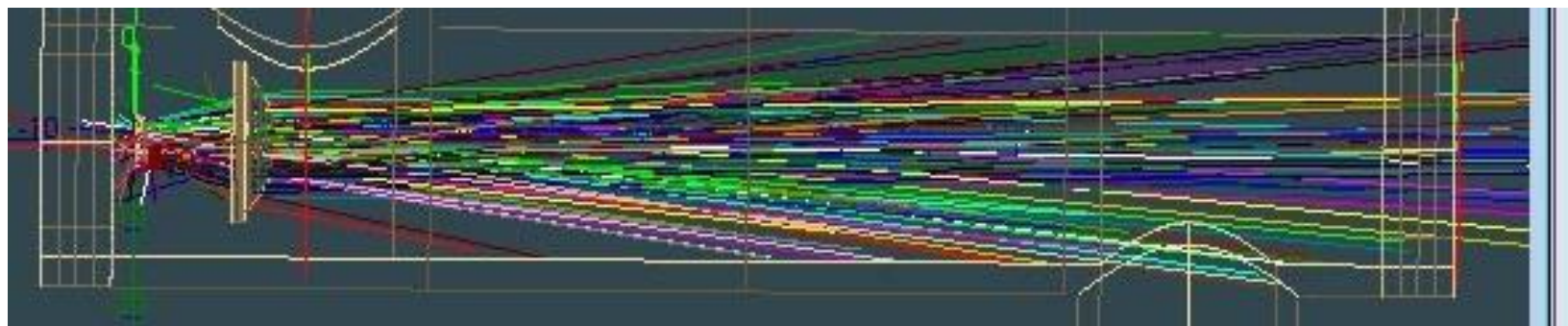
# Optimized Optical Design



10 20 30 40 50 60 mm



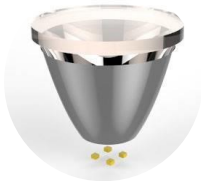
Optical  
Simulation  
in  
Sterilization  
Chamber



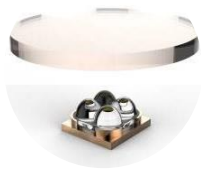
# Optimized Optical Design



562,400

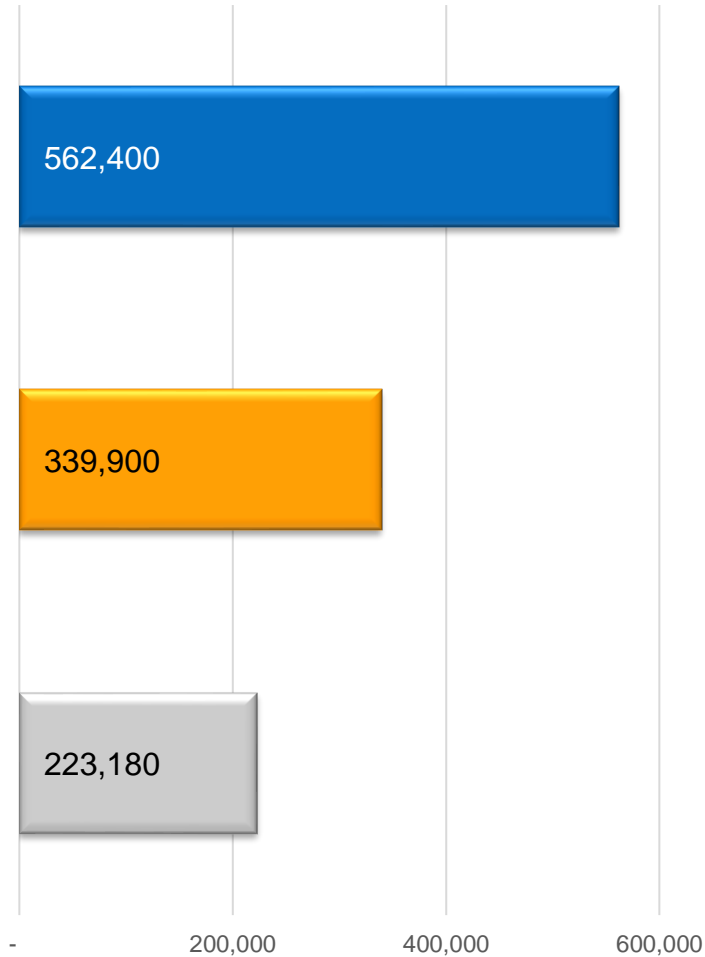


339,900

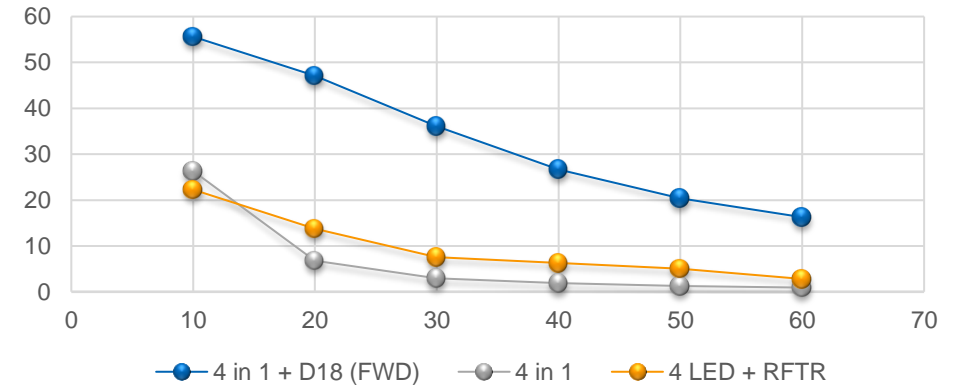


223,180

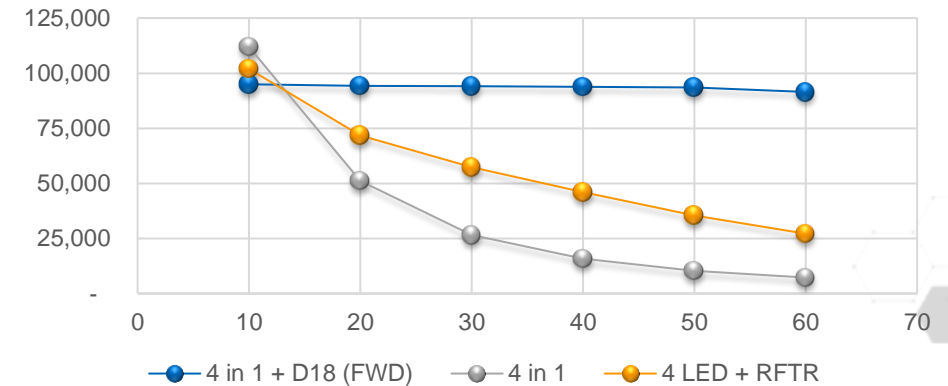
### Total Power



### Max Power

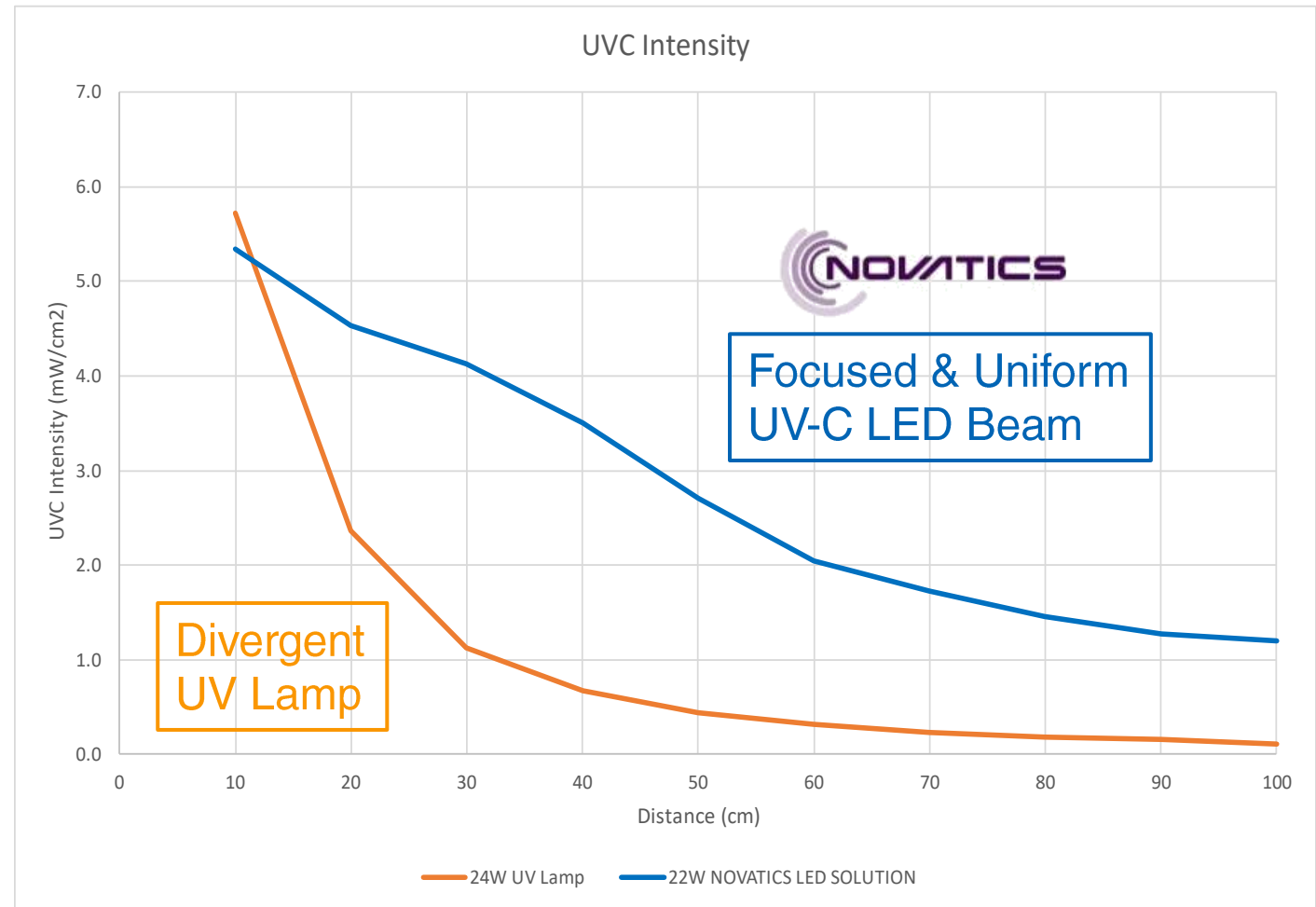


### Area Power



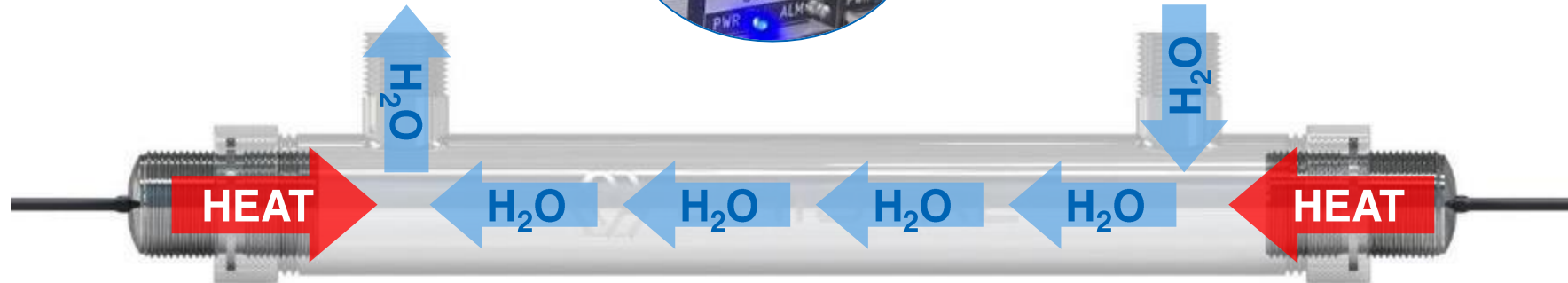


- NOVATICS WS is highly focused UV-C optical solution for long distance projection in limited channel
- Born for fluid system such as water purification and industrial air conditioner





Real time temperature monitoring

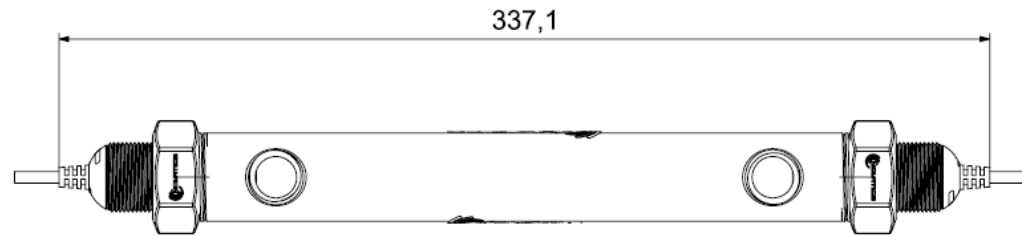


Water cooling LED module

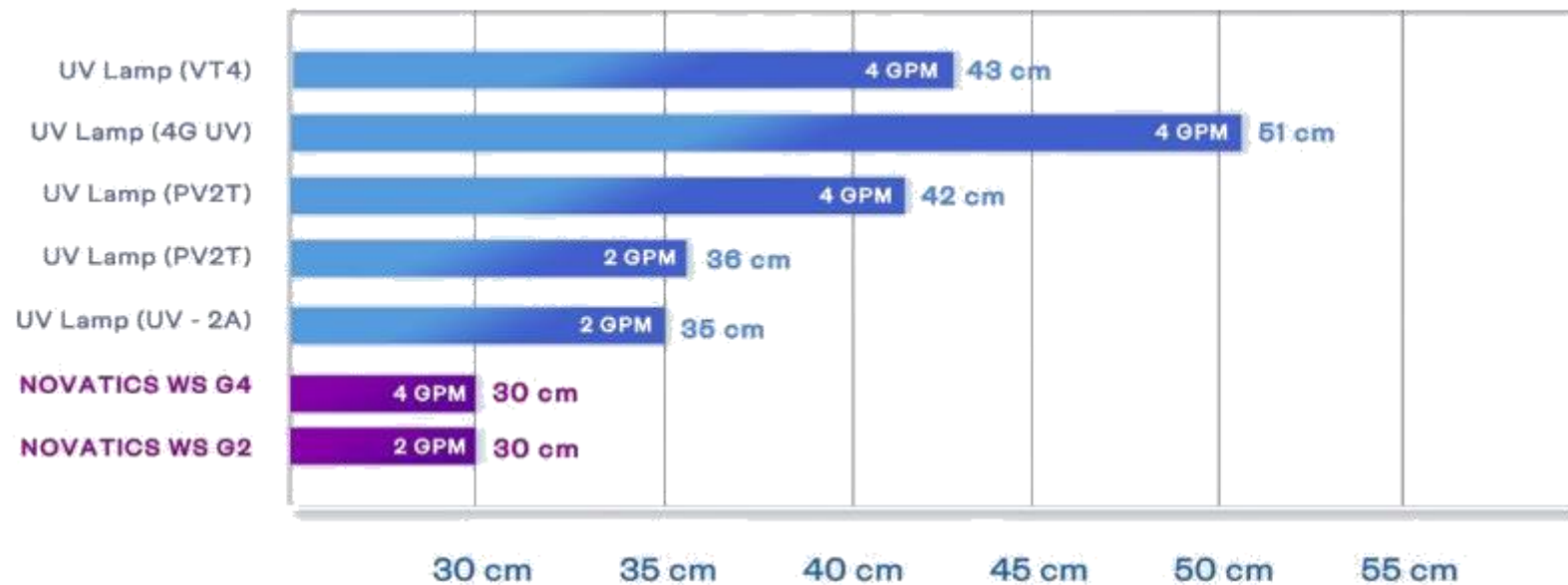
Born for high flow rate water purification



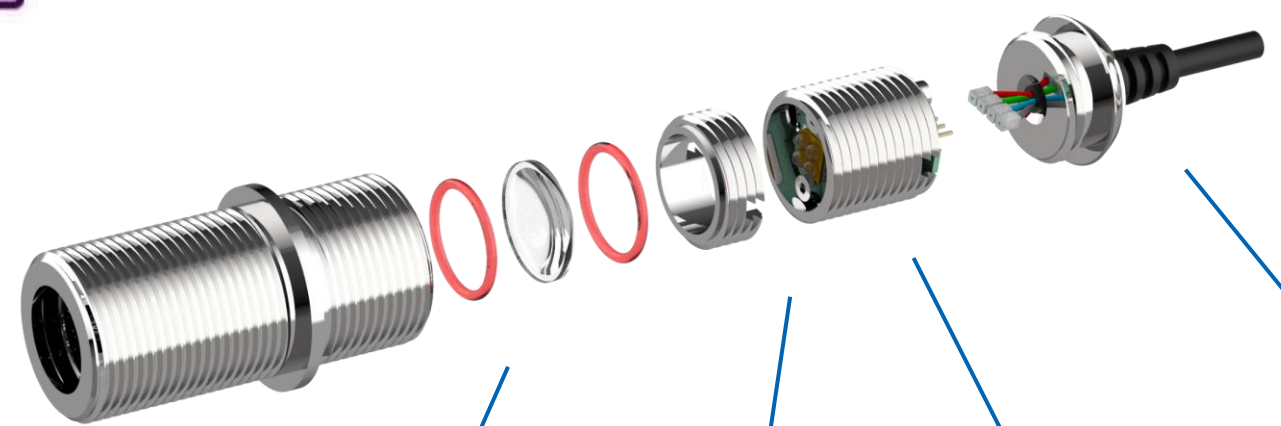
# Compact Design



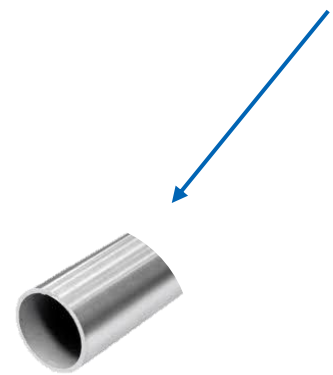
## LENGTH



# Eco Friendly Design



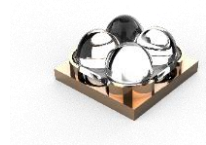
REUSABLE MATERIALS



Stainless Steel



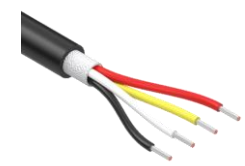
Silica Lens



UV-C LED



Aluminum



Recyclable Wire





- UV-C LED technology
- Waterproof LED module
- Min power consumption
- Mercury (Hg) free
- Intelligent functions
- Compact Design



**Mobile Food  
Truck**



**Food Industry  
Central Kitchen**



**Drinking  
Water**



**Confinement  
Center**



**Fish  
Fank**



# NOVATICS WS G Series



NOVATICS WS G Series	WS G2	WS G4
Max Flow Rate	2 GPM	4 GPM
LED Wavelength	275 nm	
LED Lifespan	4,000 hrs+	
Inlet Diameter	½ inch male	
Input Voltage	100 – 240 VAC	
System Power	5 W	10 W
System Weight	1.5 kg	1.8 kg
Applicable Temperature	15 – 35 °C	

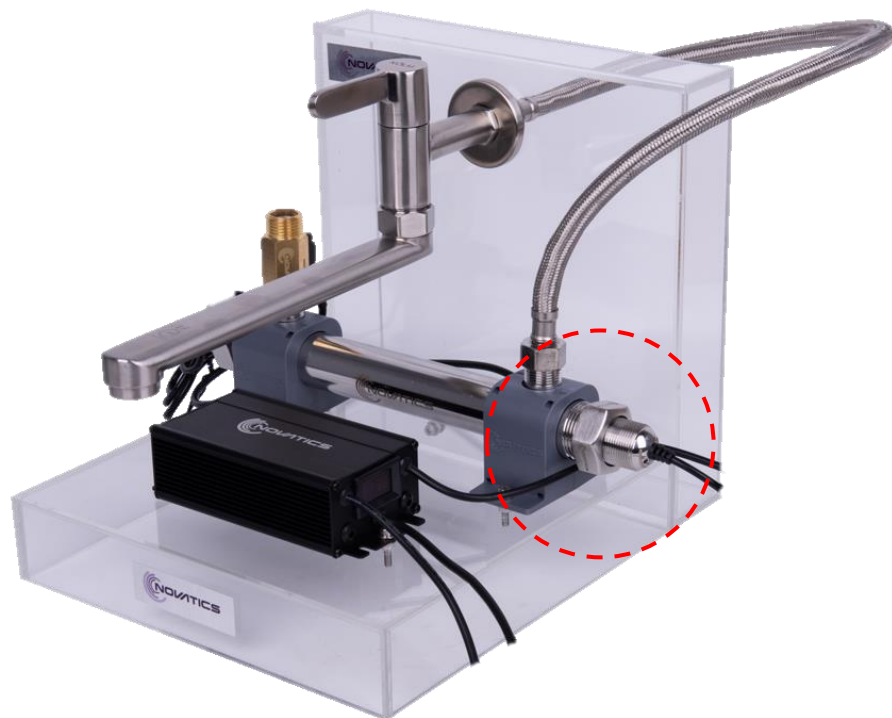




NOVATICS WS G4



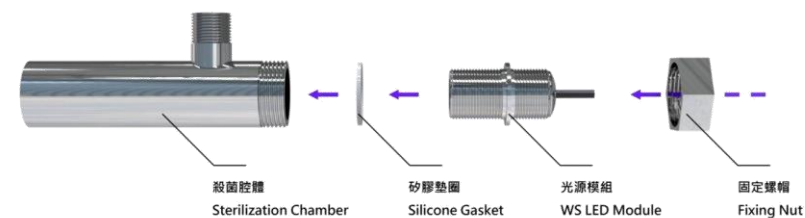
# NOVATICS Assembly Example

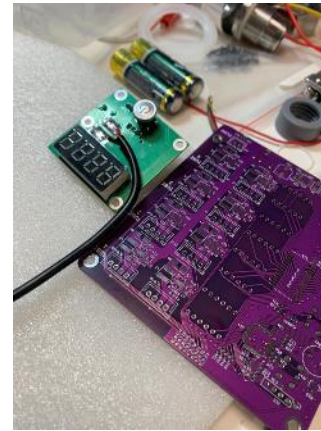
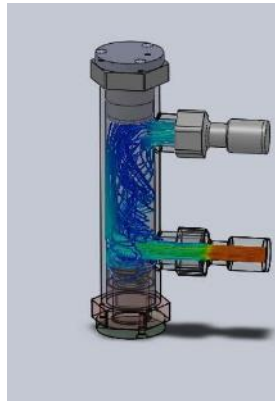
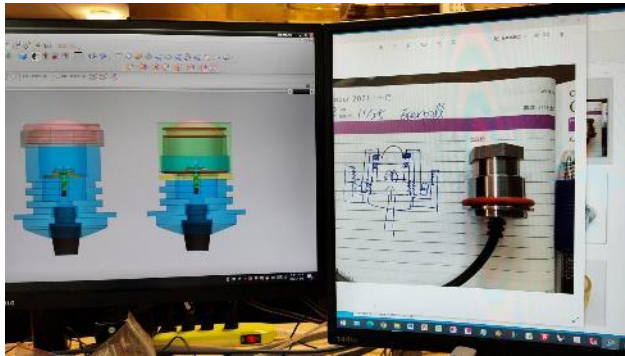


NOVATICS WS G4 for central kitchen



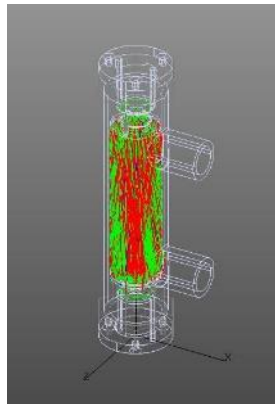
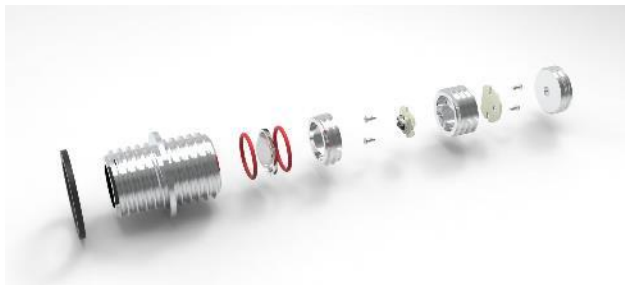
NOVATICS WS CORE  
UV-C LED Optical Module





## NOVATICS Service

- Optical Design
- Optics Manufacturing
- Fluid Dynamics
- Mechatronics Design
- Module Design
- System Integration

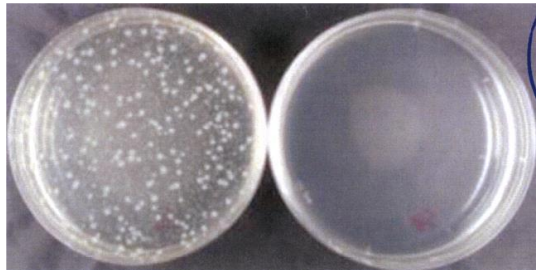


# Performance Results

# Sterilization Report



## E. Coli sterilization test



Flow Rate (LPM)	Before Sterilization (CFU/100 mL)	After Sterilization (CFU/100 mL)	Sterilization Efficiency
2.0	$4 \times 10^5$	<1	99.98%
7.5	$2 \times 10^5$	60	99.97%

財團法人食品工業發展研究所  
生物資源保存及研究中心

委託試驗報告  
TEST REPORT

委託者 Applicant: 晶盛材料股份有限公司  
取樣者 Sampler: 晶盛材料股份有限公司  
樣品名稱 Sample Name: NOVATICS UV LED 淨水器組裝機  
包裝型態 Package Type: 不適用  
批號 Lot No.:

報告編號 Report No.: 2022CT102  
送件日期 Date Received: 2022/04/07  
發件日期 Date Issued: 2022/04/11  
樣品編號 Sample No.: 2022CT102  
樣品狀態 Sample Status: 不適用

試驗項目 (Item): 菌化試驗  
結果 (Result): 未大腸桿菌 (Escherichia coli) BCR 11634 菌液試樣樣品純度，殺菌率為 99.97%。試驗內容，詳如附件。以下空白。

委託者: 晶盛材料股份有限公司  
Authorized Representative: [Signature]

備註:  
1. 本份報告僅供參考，僅對委託者所送樣品負責。  
2. 本報告所送樣品及寄送用於人體(接觸、吸入、食用等)，非本試驗之範圍。  
3. 本報告所送樣品，僅供參考資料，並非用於產品、設備或商業用途，應與本所同意。  
This report is for reference only, if it is used for advertisement, sales promotion, or material use, please consult FIRD first.

第一頁/全一頁 T-CR-011

# Sterilization Report



## Test Conditions

Target: *E. coli*

Concentration:  $10^5$  CFU/mL

Flow Rate: 2 GPM

Test in Japan

## 2GPM test results of WS G2/G4

Model	Performance
WS G2	97.21%
WS G4	99.95%

## ☐ Sterilization Test(G2, G4)

Sample arrival date	August . 1
Sterilization Test	August . 3 ~ 10
Bacteria	E.Coli
Flow Rate	7.5 L/min (2 G/min)
Operating Condition	Use attached power supply



## ☐ Result

		Sterilization[CFU/mL]	LRV	Fig.	
				Before	After
G2	Before	7.9E+05	1.5		
	After	2.2E+04			
G4	Before	7.2E+05	3.3		
	After	3.2E+02			

# Lab Performance Certificate



Experiment conditions explained by researcher of Taiwan University Lab

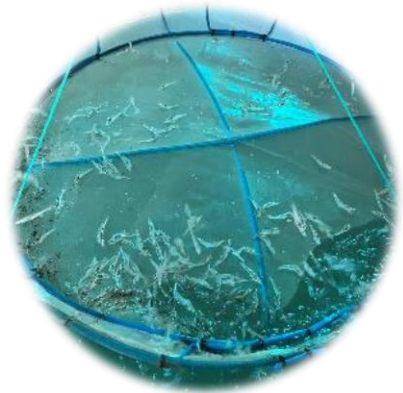


Lab test results of WS G4

Flow Rate	Performance
2 GPM	99.98%
4 GPM	97.69%



# Shrimp Farm Test

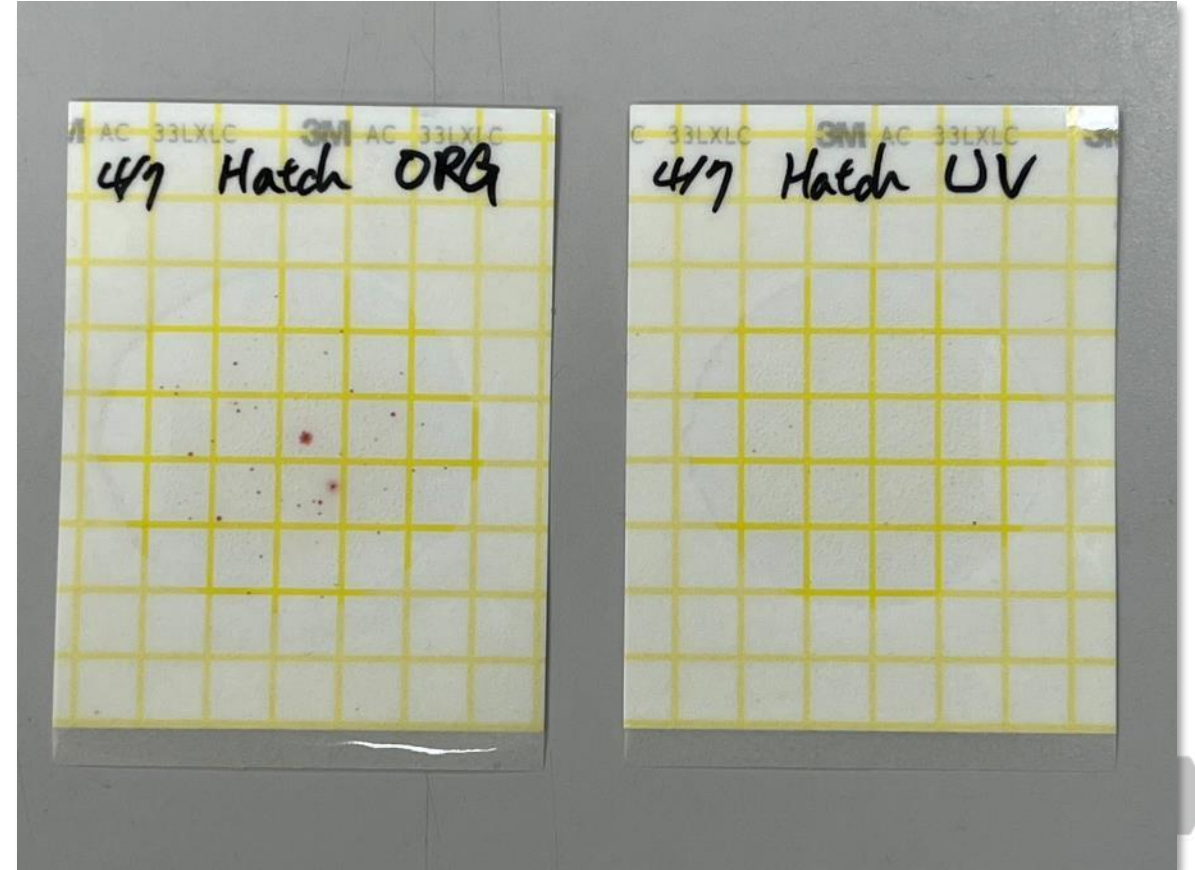


Model: WS T10 Matrix

Flow Rate: 5 m<sup>3</sup>/hr



# Murry Cod Hatchery Test



# Murry Cod Hatchery Test



## Murry Cod Hatchery

Flow Rate: 5 m<sup>3</sup> / hr



Model: 4WS T5 Concept  
Flow Rate: 3.5 m<sup>3</sup>/hr

YEAR	CONDITION	EGGS	HATCHES	HATCH RATE	PERFORMANCE
2022	NO UV TREATMENT	10,000 (rough)	353	3.5%	
2023	NOVATICS 4WS TEST	10,000 (rough)	1,178	11.8%	

NOVATICS 4WS Concept enhances hatch rate by 3 times

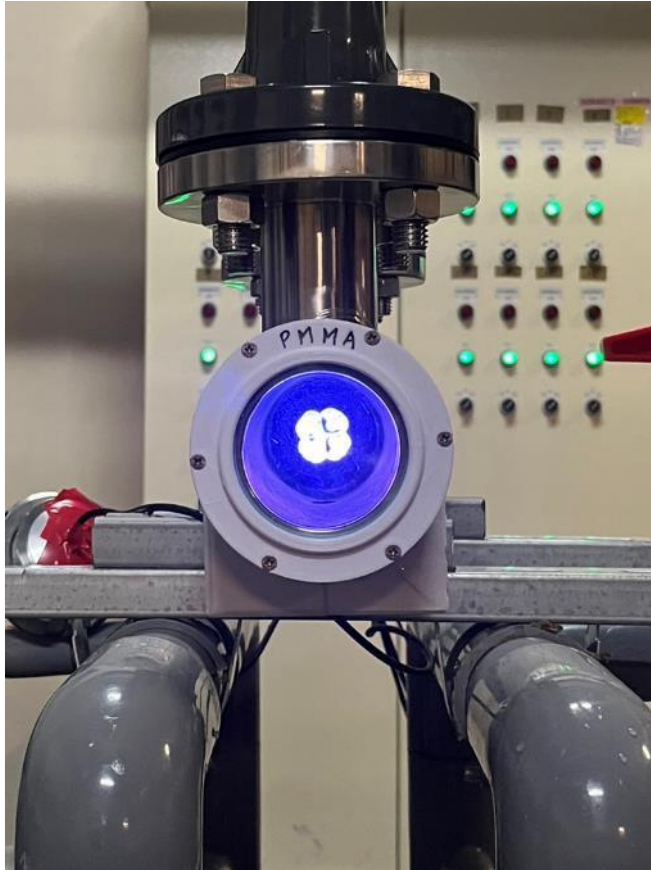


# SPA Pool Test



Model: WS T10 Matrix

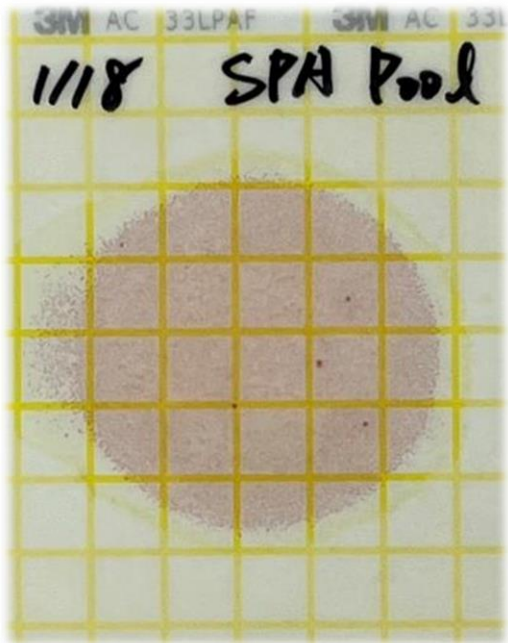
Flow Rate: 9 m<sup>3</sup>/hr



# SPA Pool Test Comparison



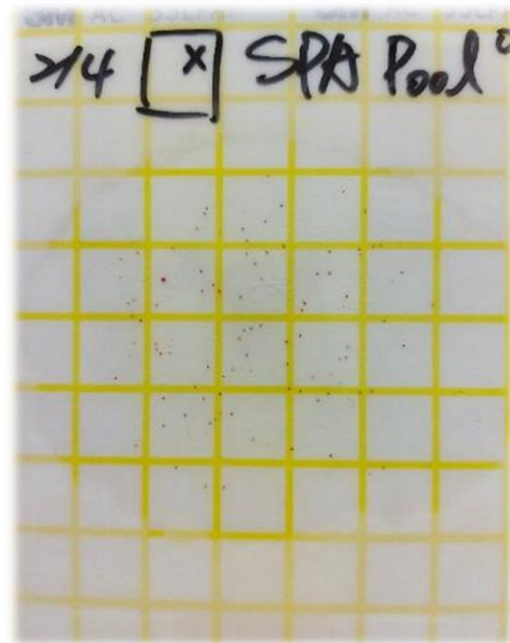
No treatment in water for 12 hrs



$3 \times 10^6$  CFU/mL



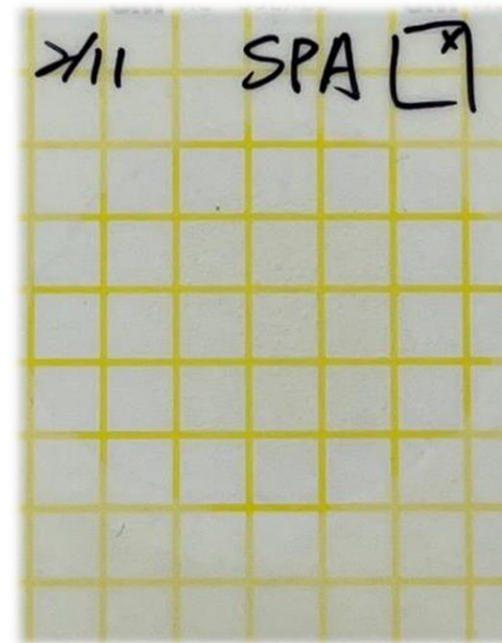
UV circulation only for 24 hrs



146 CFU/mL



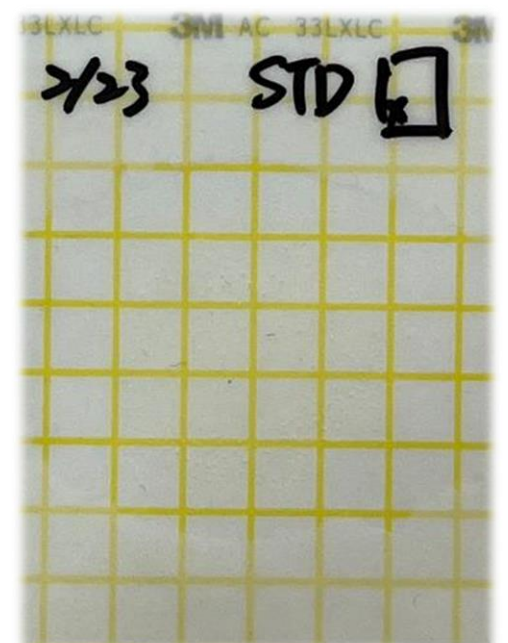
UV circulation + 0.5 ppm Cl



1 CFU/mL

(Reference)

Regular Cl 1.5 ppm



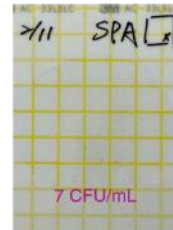
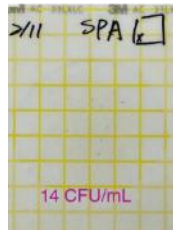
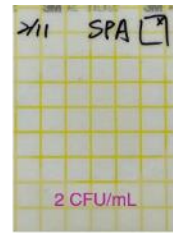
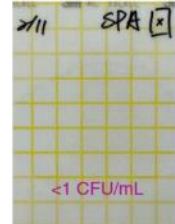
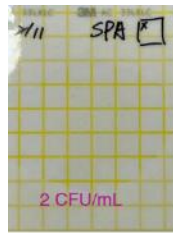
2 CFU/mL

# Continuous Test Results

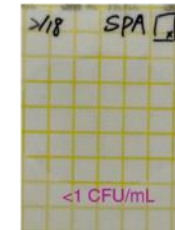
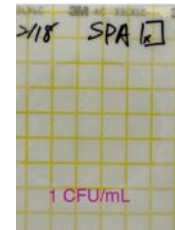
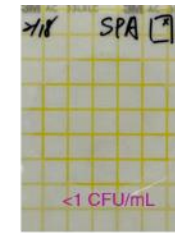
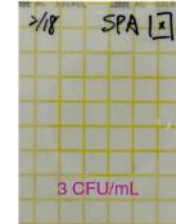
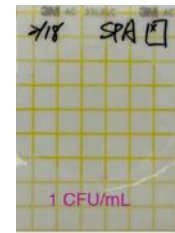


UV circulation  
with 0.5 ppm Chlorine

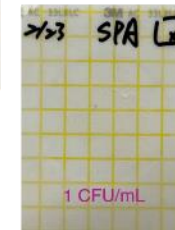
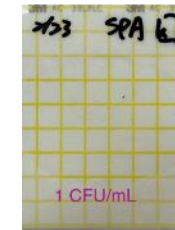
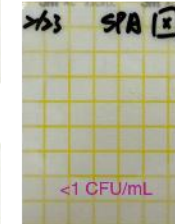
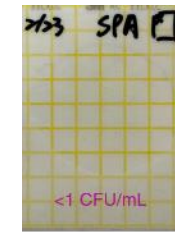
2/11



2/18



2/23



# Algae Removal for Aquarium



Greenish algae water to be removed in 3 days by NOVATICS WS G2 (3 ft tank)



# Algae Removal Test



NOVATICS WS G4

Greenish Water Test for 60 hrs



NOVATICS WS G4

Crystal Clear Water in 60 hrs



# Chlorine Removal Test



Chlorine in tap water will be removed by NOVATICS WS in 30 mins (circulation)

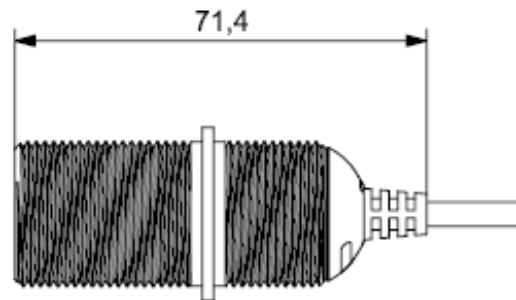
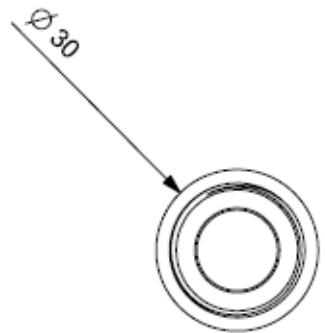


# NOVATICS WS Specs



## NOVATICS WS CORE

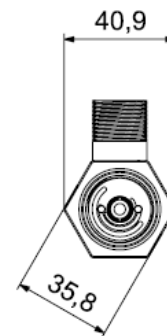
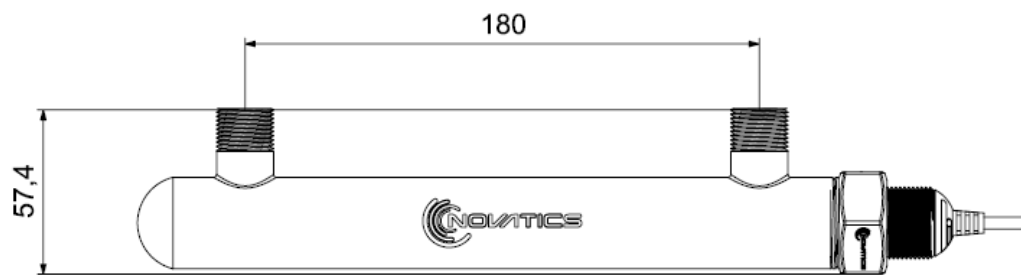
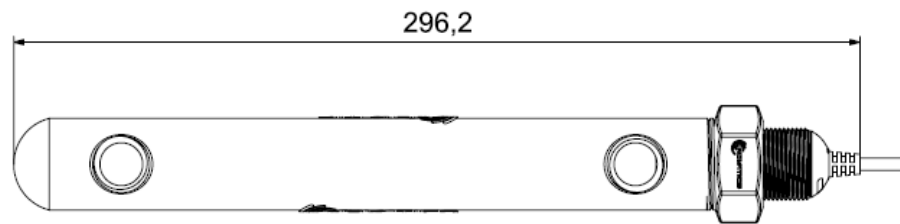
- Max Flow Rate 2 GPM
- Power 5 W
- Dimension 71.4 mm
- Lifetime 4,000 hrs+





## NOVATICS WS G2

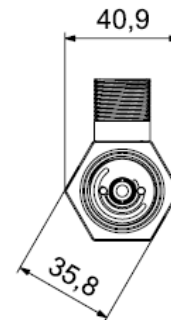
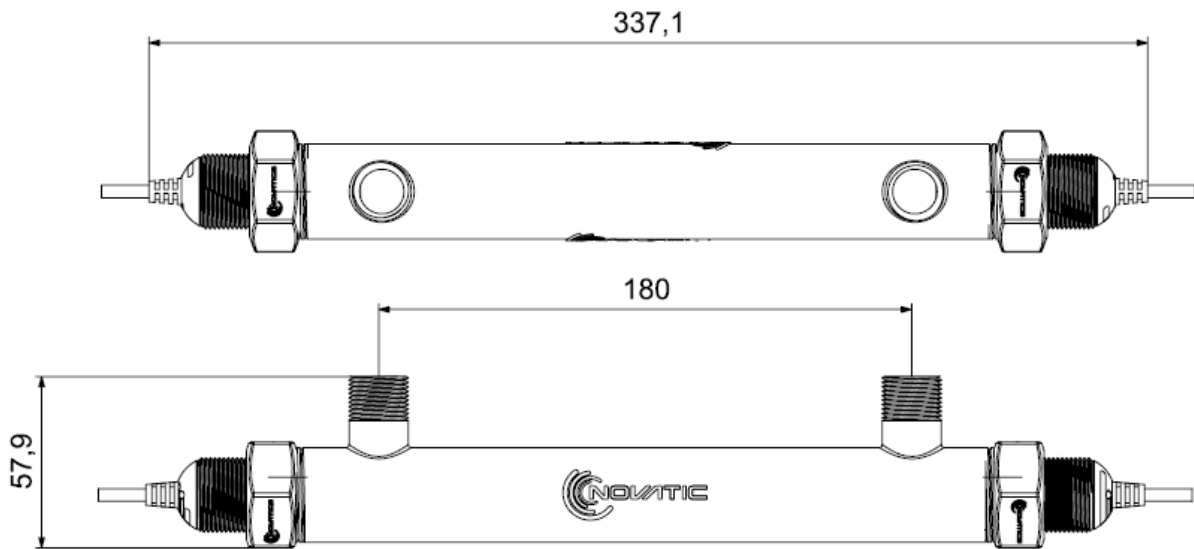
- Max Flow Rate 2 GPM
- Power 5 W
- Dimension 296 mm
- Inlet Diameter 1/2 in





## NOVATICS WS G4

- Max Flow Rate 4 GPM
- Power 10 W
- Dimension 337 mm
- Inlet Diameter 1/2 in

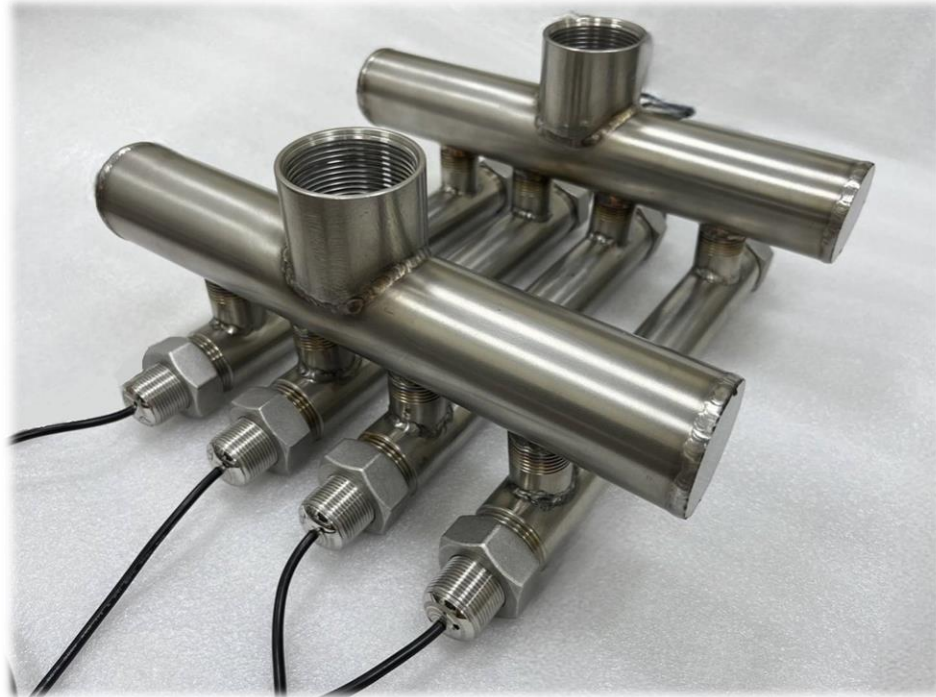




## NOVATICS WS-F Faucet

- Max Flow Rate 2 GPM
- Power 5 W
- Dimension 60 mm
- Inlet Diameter 1/2 in





## NOVATICS WS T5 Matrix

- Max Flow Rate 20 GPM
- Power 40 W
- Height 15 cm
- Width 30 cm
- Depth 30 cm
- Inlet Diameter 1½ in
- Control Panel Standard
- Power Supply Standard

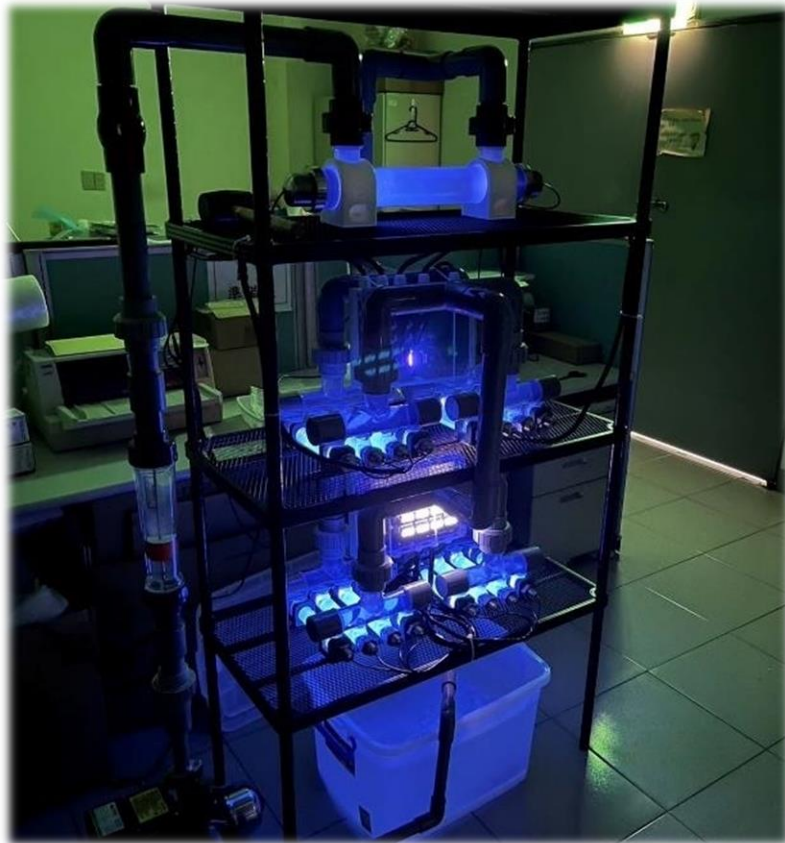




## NOVATICS WS T10 Matrix

- Max Flow Rate 40 GPM
- Power 80 W
- Height 15 cm
- Width 75 cm
- Depth 30 cm
- Inlet Diameter 1½ in
- Control Panel Standard
- Power Supply Standard





## NOVATICS WS T25 Matrix

- Max Flow Rate 100 GPM
- Power 210 W
- Height 180 cm
- Width 90 cm
- Depth 45 cm
- Inlet Diameter 2 in
- Control Panel Standard
- Power Supply Standard



# Applicable applications



**WS LED Module**



**WS G2**

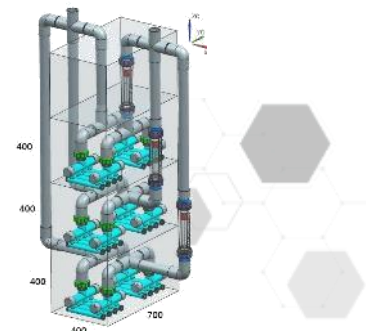


**WS G4**

**WS T5**

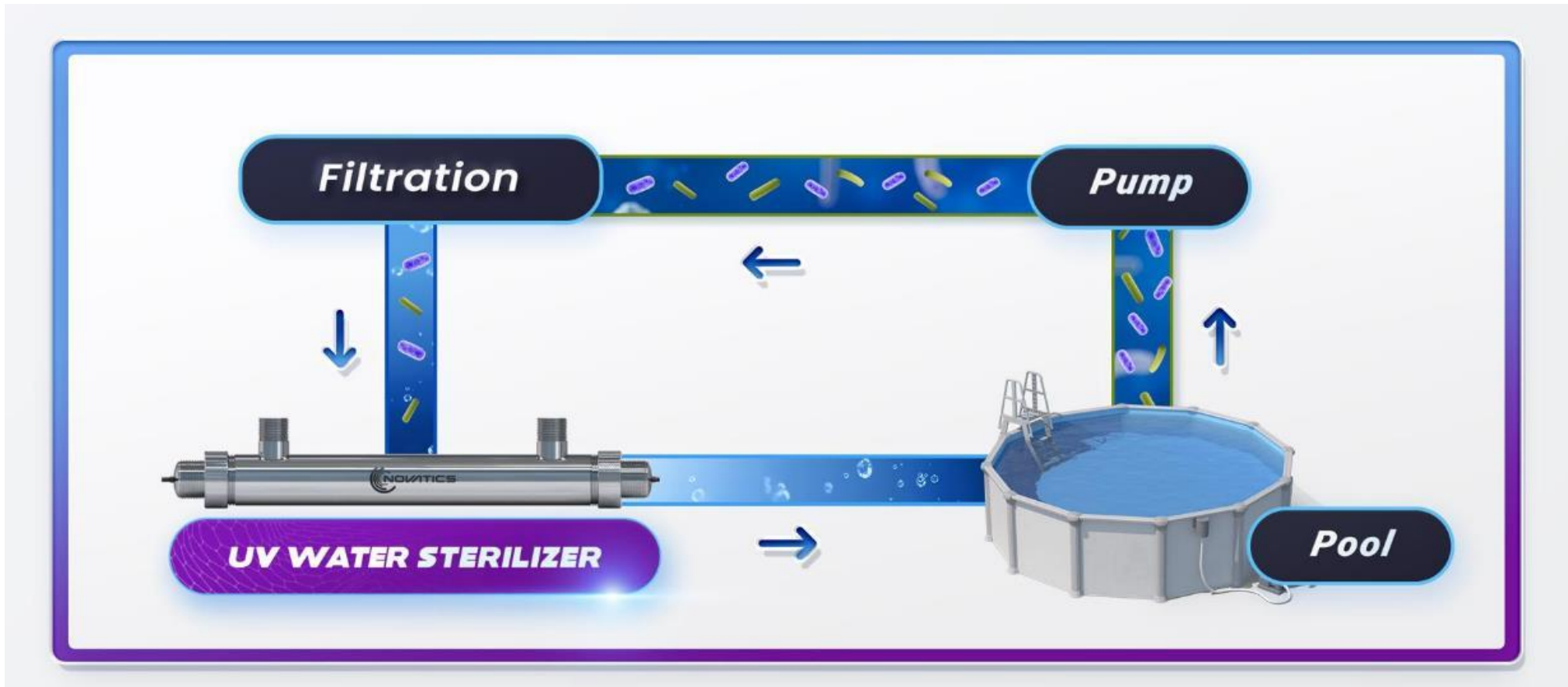


**WS T10**

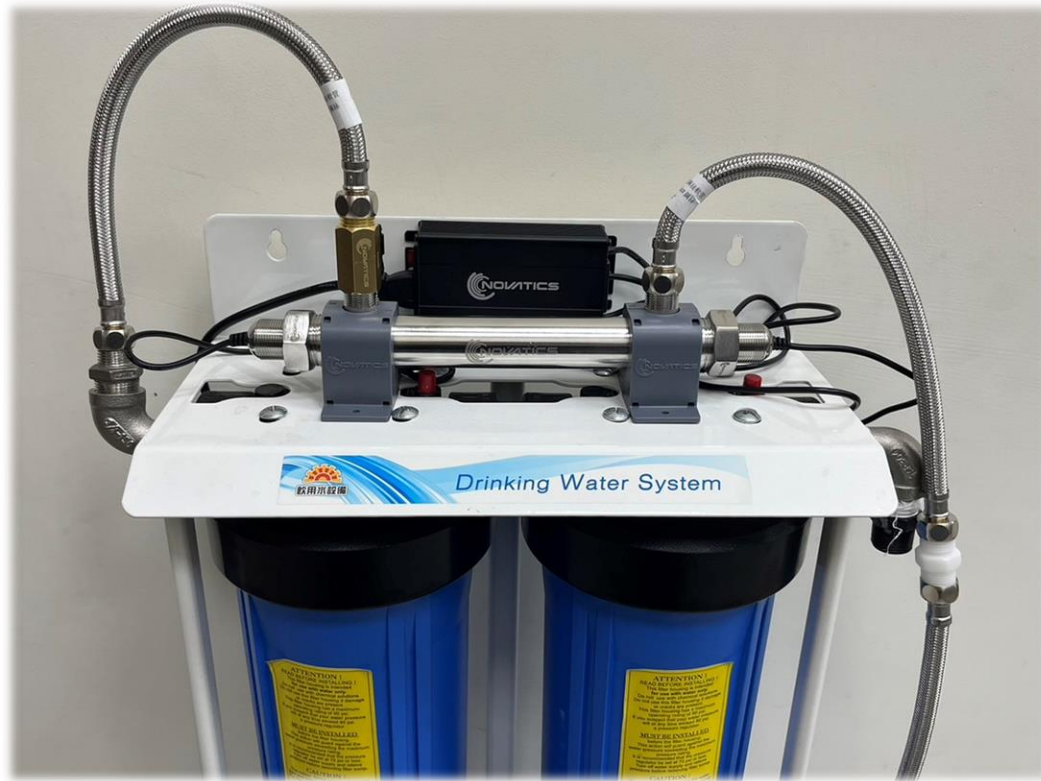


# Real Site Achievements

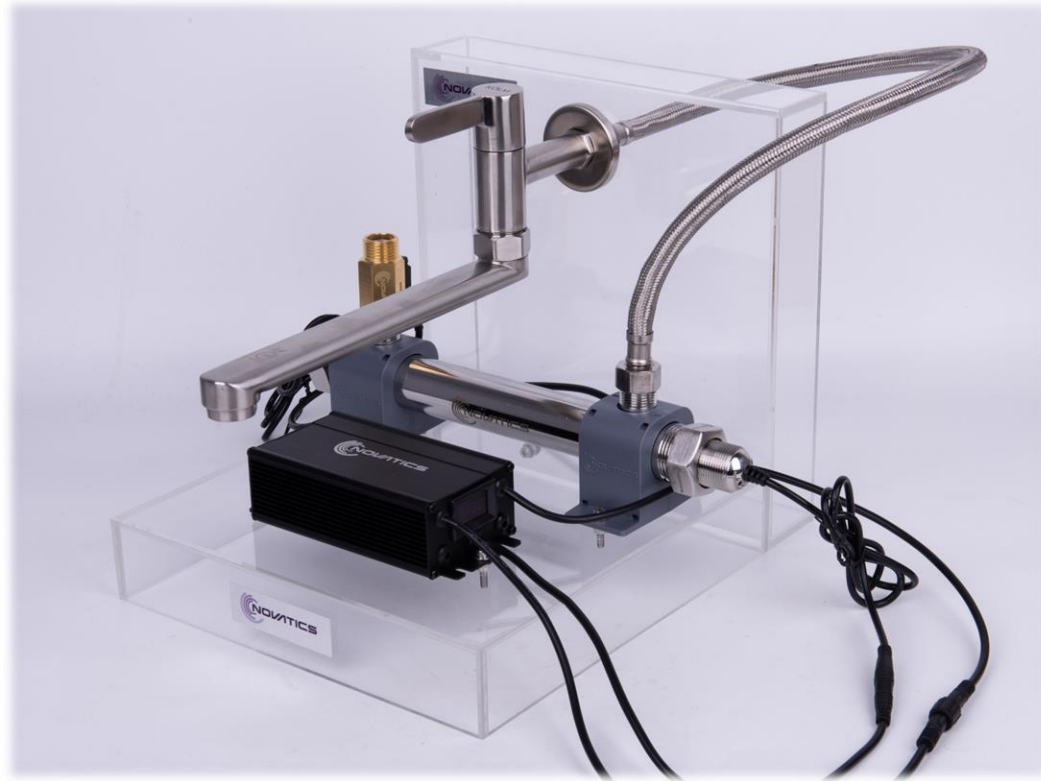
# Connection Example



# Household Drinking Water



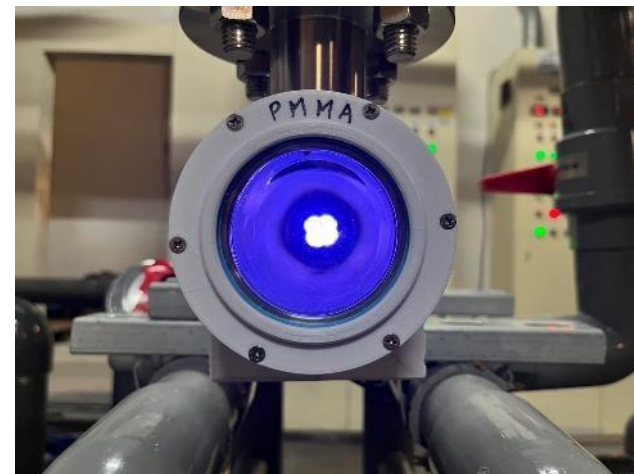
# Central Kitchen Faucet



# Pig Farm Drinking Water



# SPA Pool (WS T10)



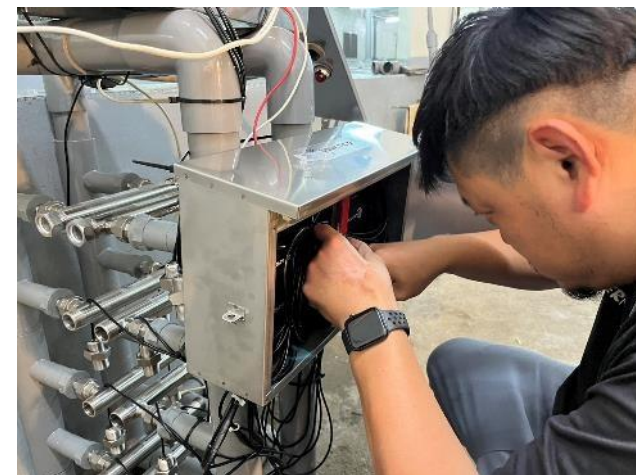
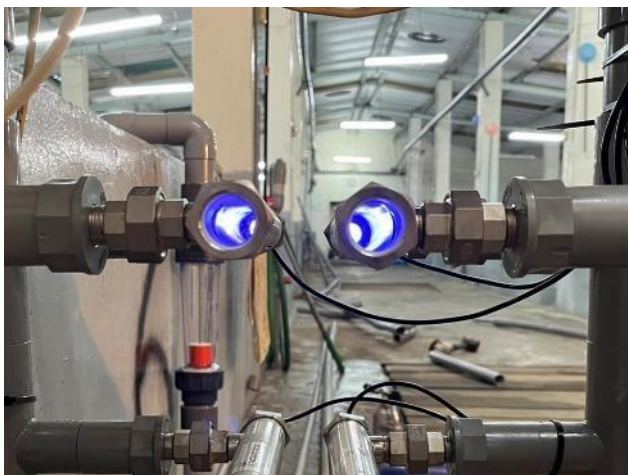
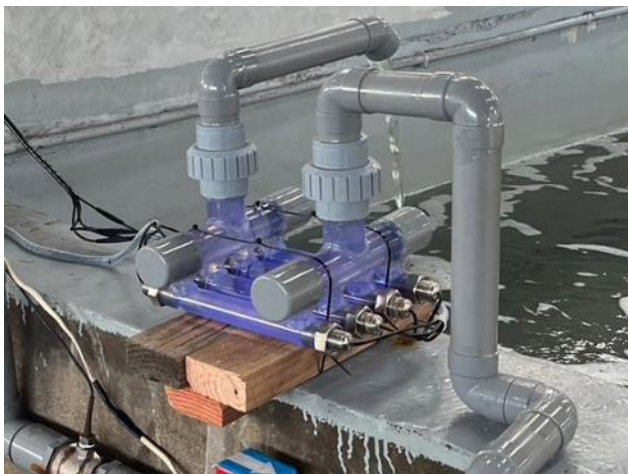
# Tilapia Farm (WS T10)



# Sturgeon Farm (WS T10)




# Shrimp Farm (WS T5)



# Company Profile

# Cristal Materials Corporation



Company	Cristal Materials Corporation
Establish	2006
Process	Nano Sol-Gel process
Material	Fused Silica
Certificate	ISO 9001 / ISO 14001
Brands	<b>NOVAXIL™ silica optics</b>
	 <b>NOVATICS</b> UV-C LED solutions
Service	Optics manufacturing Optical design & Optical simulation UVC LED module integration



Since 2006



- Core
- Vision
- Mission

Sol-Gel technology

Better life with NOVAXIL™

Customer orientated service

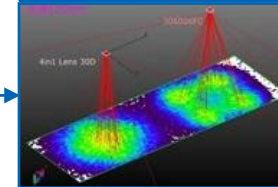
Since 2008

Optics MFG



MFG technical support

Module Design



Since 2015



UV LED lens



2008

Secondary lens



2010

Lens array



2016

PCB module



2015

UV LED module



2020





## Continuous improvement

- 1) Complex geometry
- 2) Freeform design
- 3) Microstructures



**CRISTAL**

## Applications

- 1) UV LED packages
- 2) PCB / 3DP / Printing
- 3) Laser projector



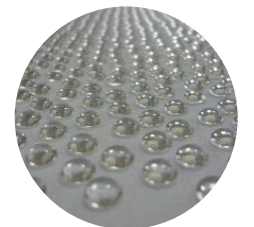
## Advanced study

- 1) Head up display (HUD)
- 2) Laser optics
- 3) Bio-Med analysis
- 4) UVC sterilization



## Mass production

- 1) Aspheric lens
- 2) TIR optics
- 3) Flyeye lens
- 4) Microlens array

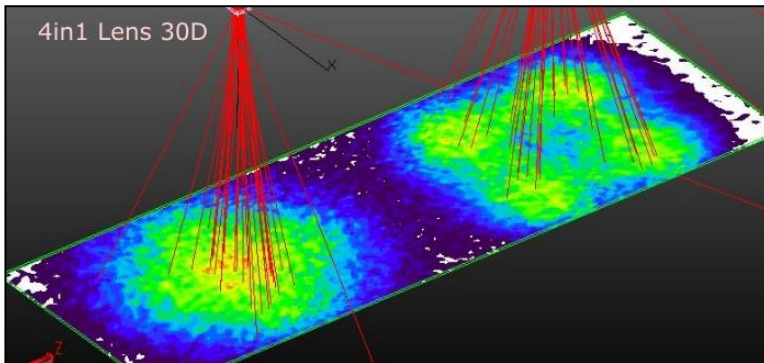


# NOVAXIL™ silica optics



CRISTAL





Optics  
Manufacturing

Optical Design

Electronic Design



Material Science

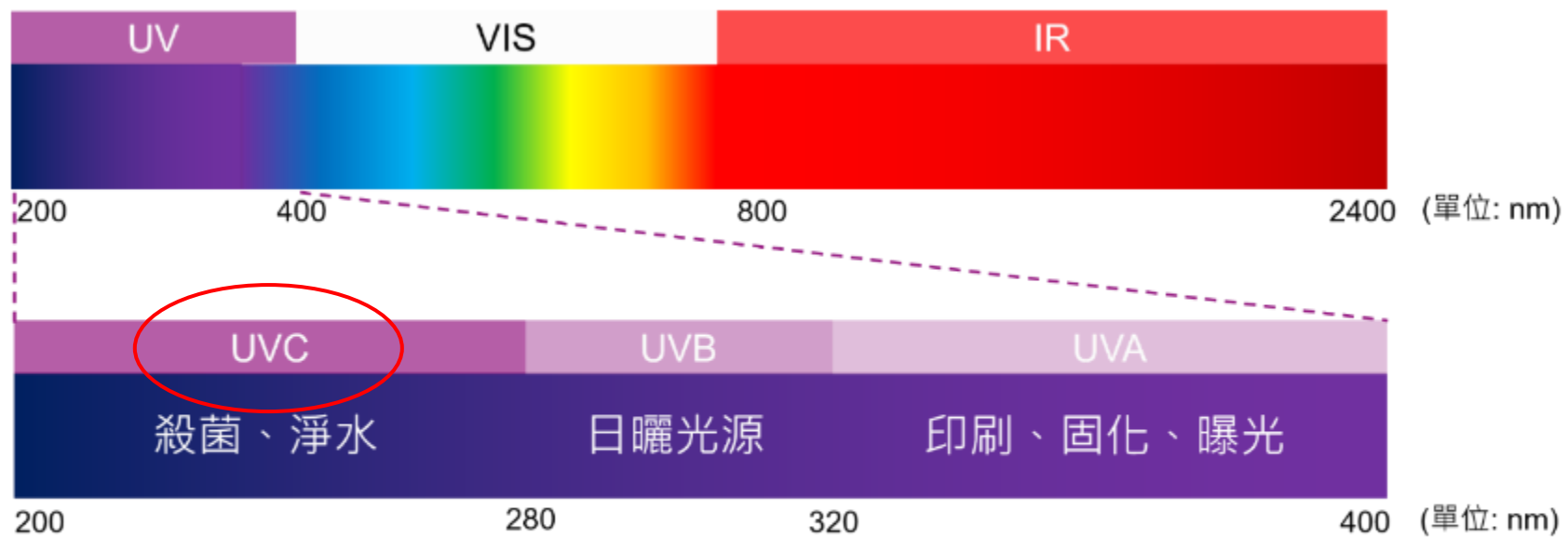
Fluid Dynamics

Module  
Integration



# Backup Slides

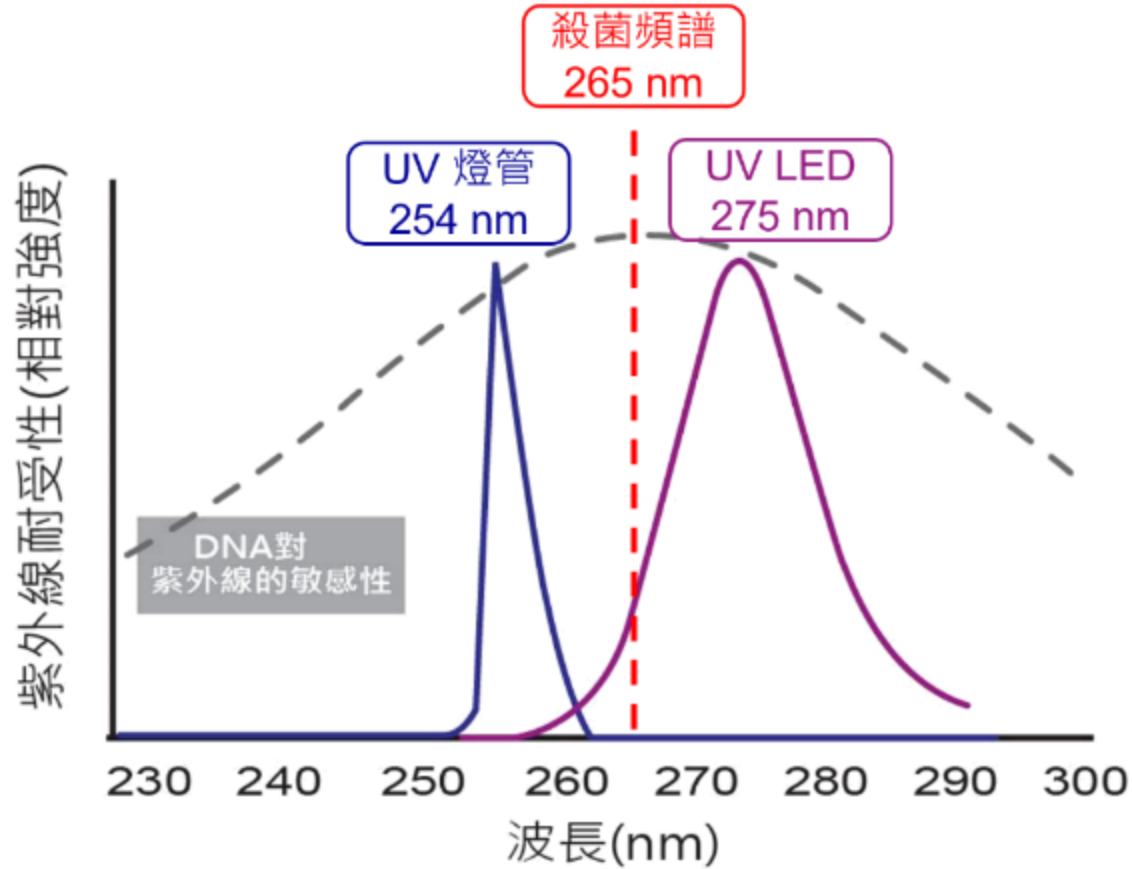
UVC spectrum & LED Sterilization



光學全波長頻譜示意圖



# UVC sterilization



UVC殺菌頻譜範圍





**CRISTAL**

[cristalmat.com](http://cristalmat.com)