

**SAMSUNG**

Specialty Lighting

# Horticulture Lighting Solutions

**식물생장용 LED**



# 식물생장 조명 트렌드

## 농업 및 원예 조명의 진화

LED는 농작물의 생산성을 높일 뿐 아니라 조명 시스템의 설치 및 운영에 따른 비용절감



	백열등	MH	HPS	LED
효율 (μmol/J)	1.0	1.4	1.8	> 2.5
열	Low	High	High	Low
수명 (시간)	< 20,000	< 20,000	< 30,000	> 50,000
웜업시간	Short	Long	Long	Short
디자인 편의성	Low	Low	Low	High
스펙트럼 조절기능	Low	Low	Low	High

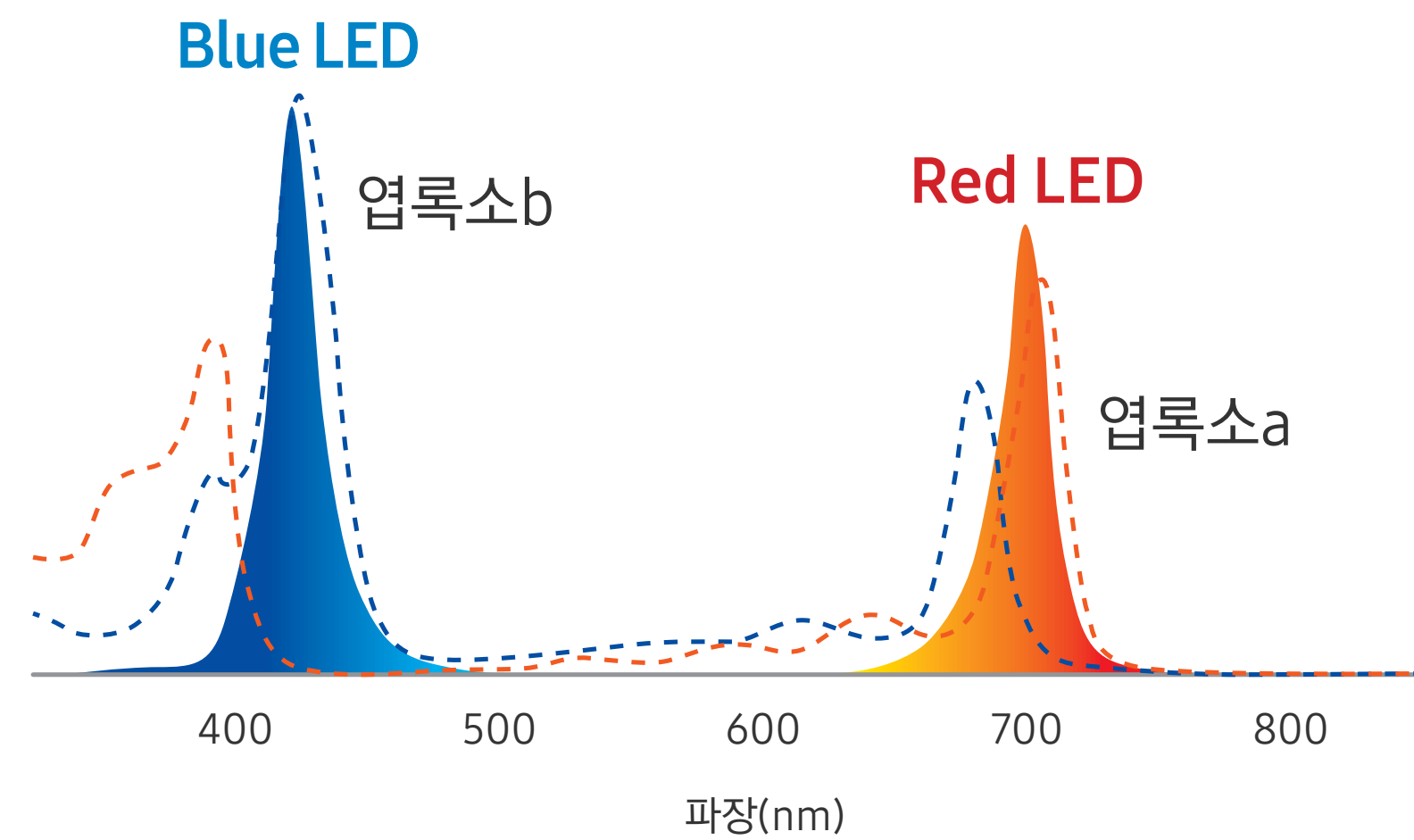


# 식물성장 조명 트렌드

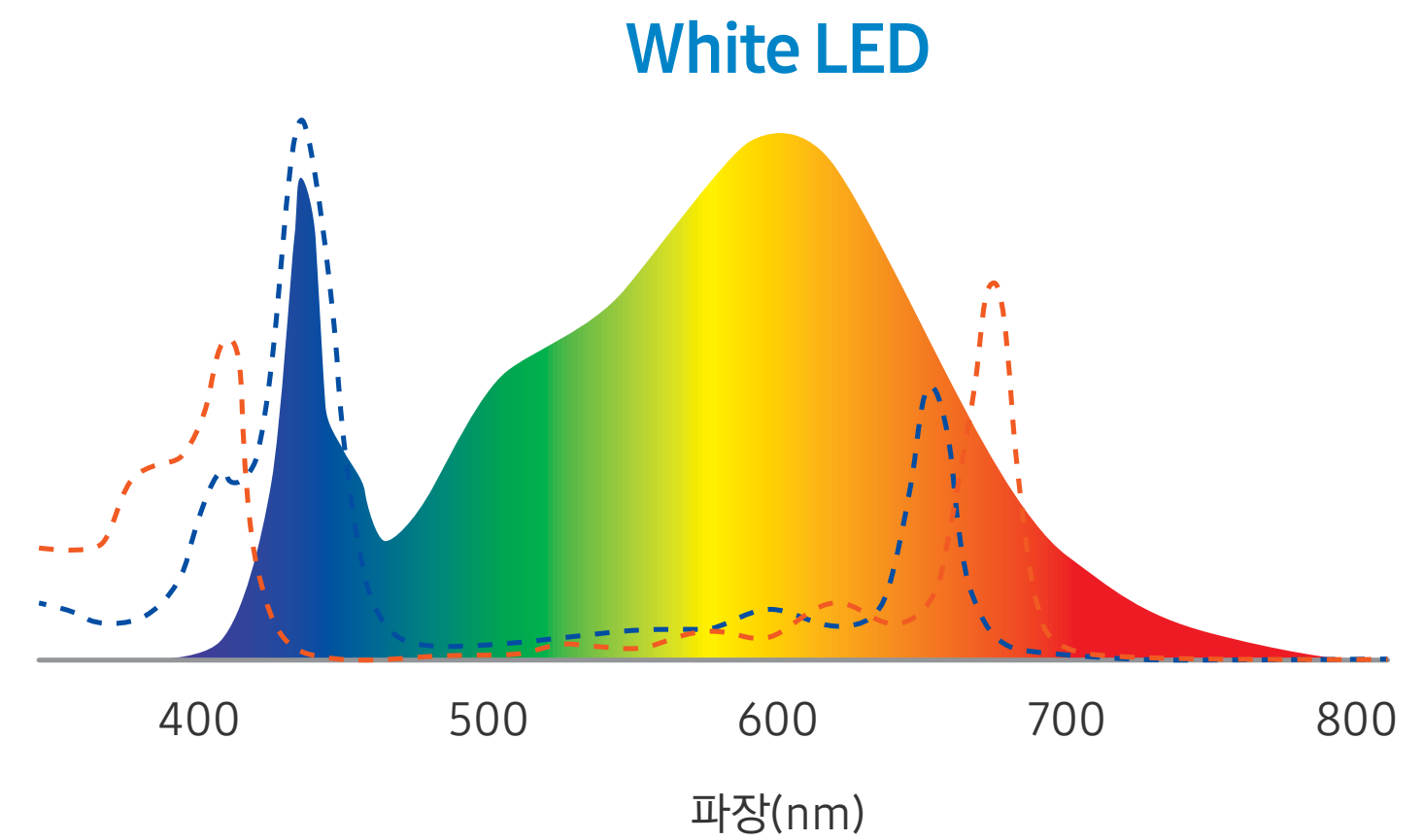
## 경쟁력을 갖춘 풀 스펙트럼 LED

비용 효율성 및 생산성 측면에서 경쟁력을 갖춘 최신 기술

### 일반 스펙트럼 LED

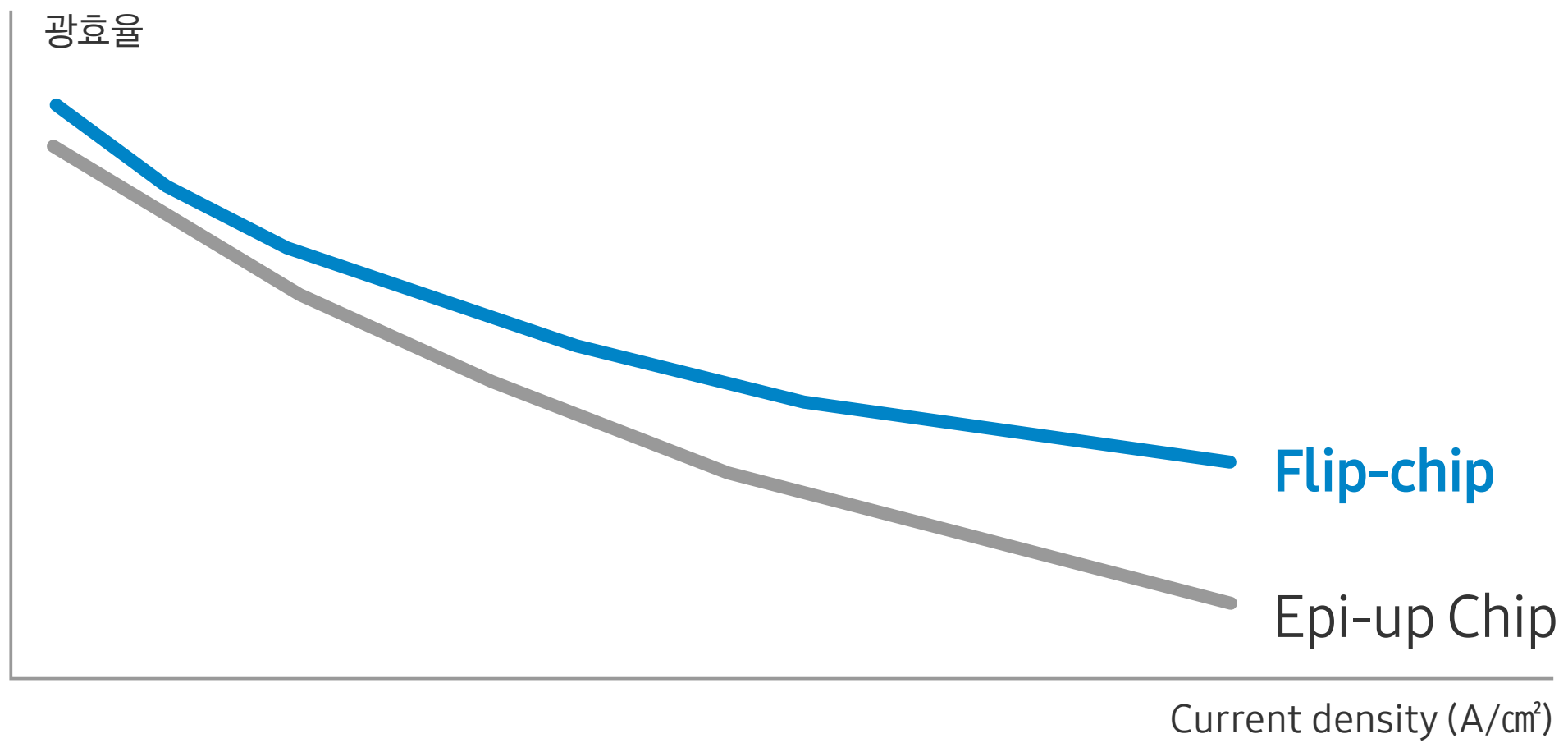
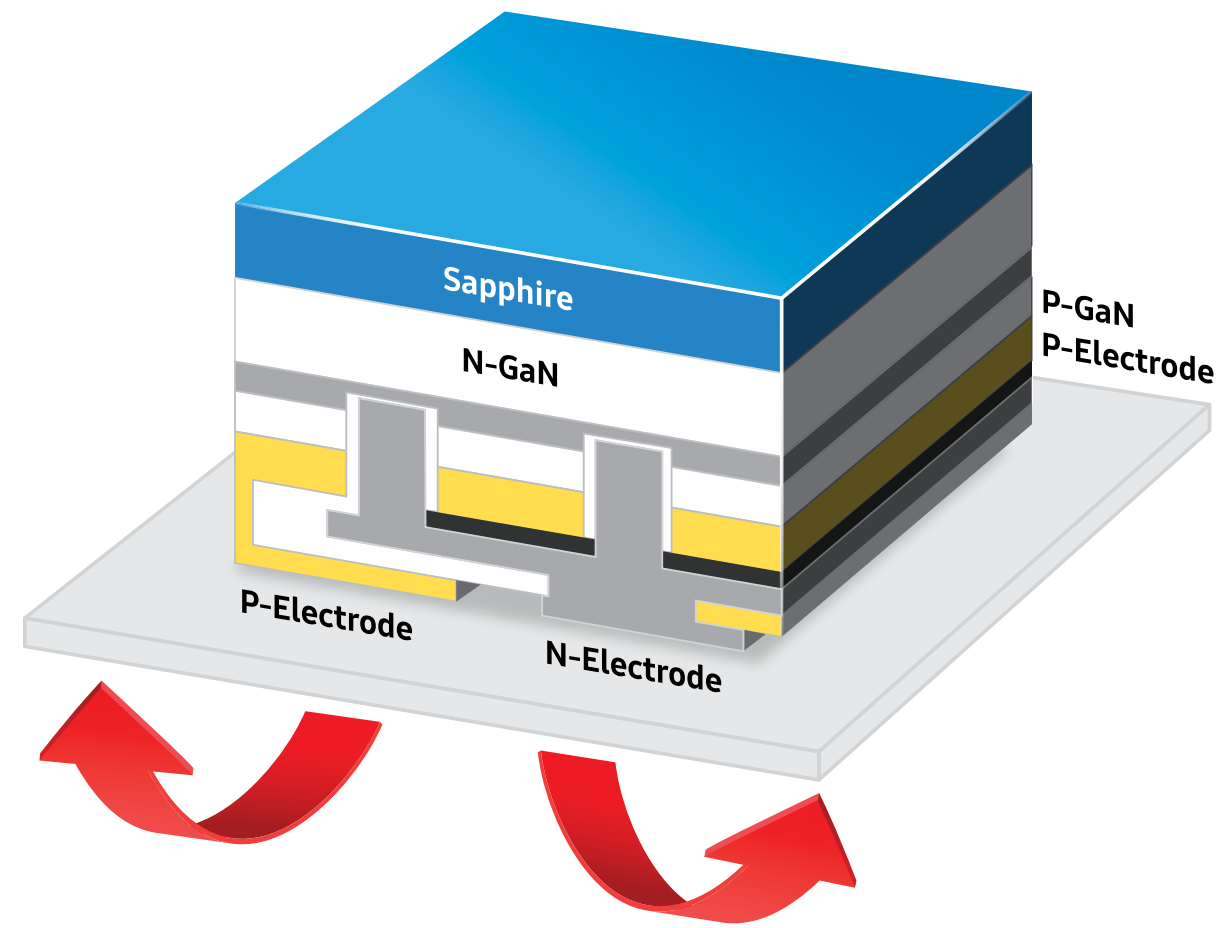


### 풀 스펙트럼 LED





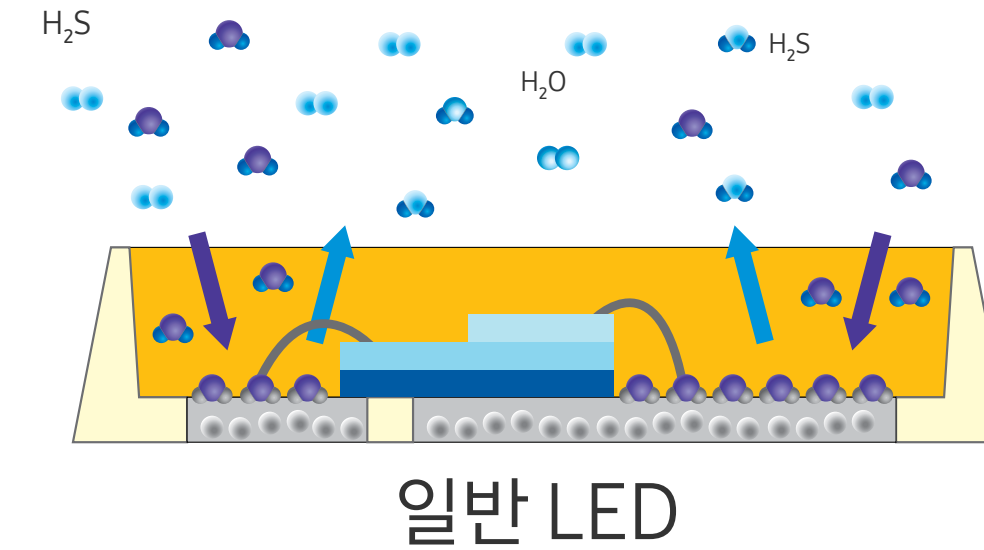
## 와이어를 사용하지 않는 플립칩 구조로 불량 요인 제거



## 유황성분에 대한 저항력이 강화된 패키지 구조

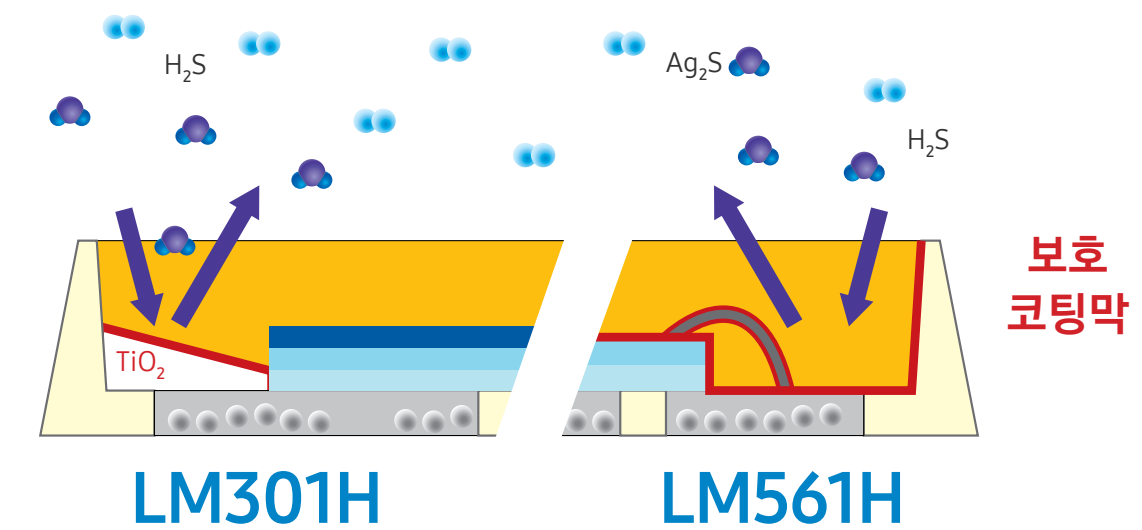
### 일반 리드프레임 패키지

- 와이어나 전극에 포함된 Ag 성분은 H<sub>2</sub>S (황화수소)에 노출될 경우 산화될 수 있음
- $2Ag + H_2S + 1/2O_2 \rightarrow Ag_2S + H_2O$  (Ag<sub>2</sub>S 는 PPF 감소 야기)



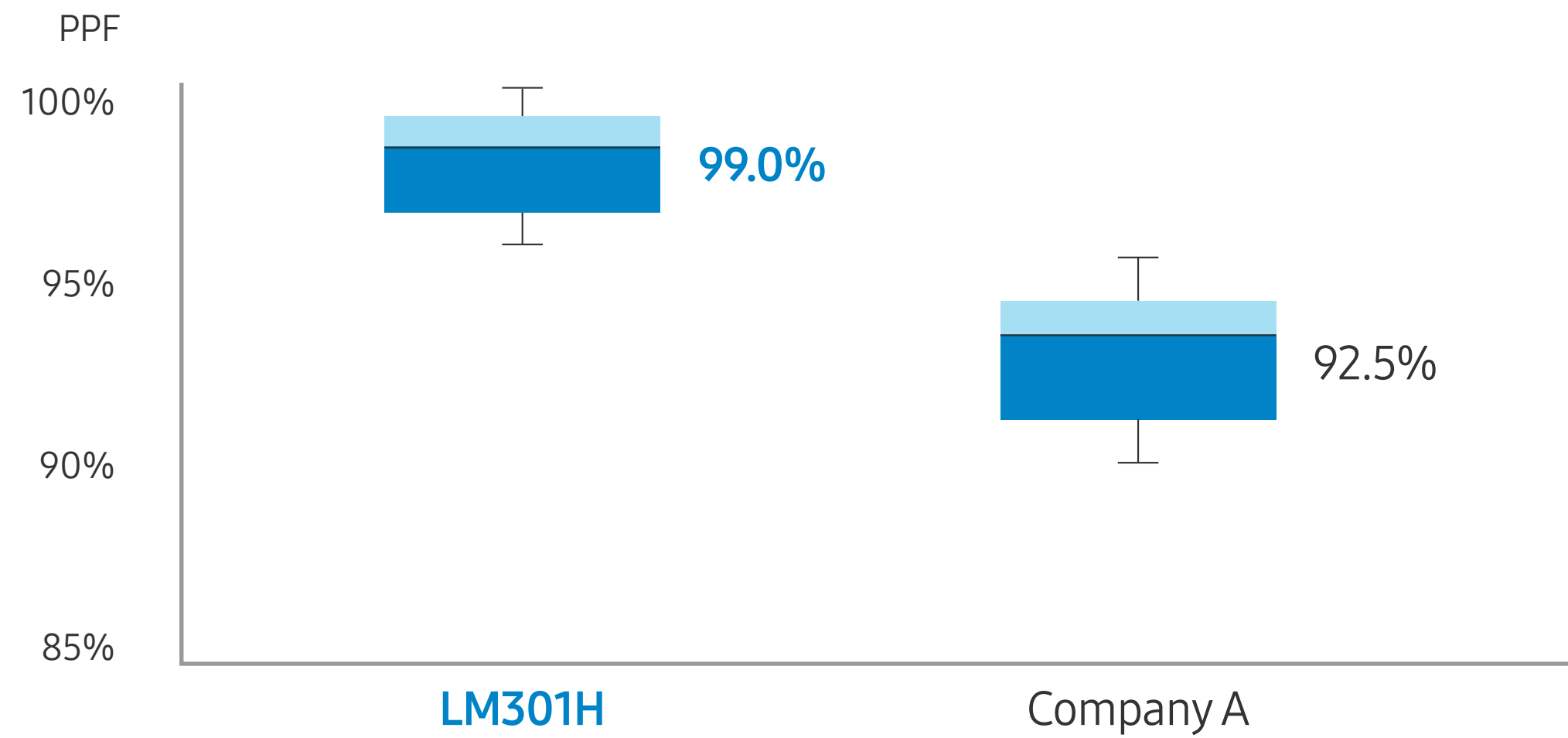
### 삼성 식물생장용 패키지

- LM301H: 와이어 없는 플립칩 구조
- LM561H, LH351H: Ag 노출 방지 코팅막 적용



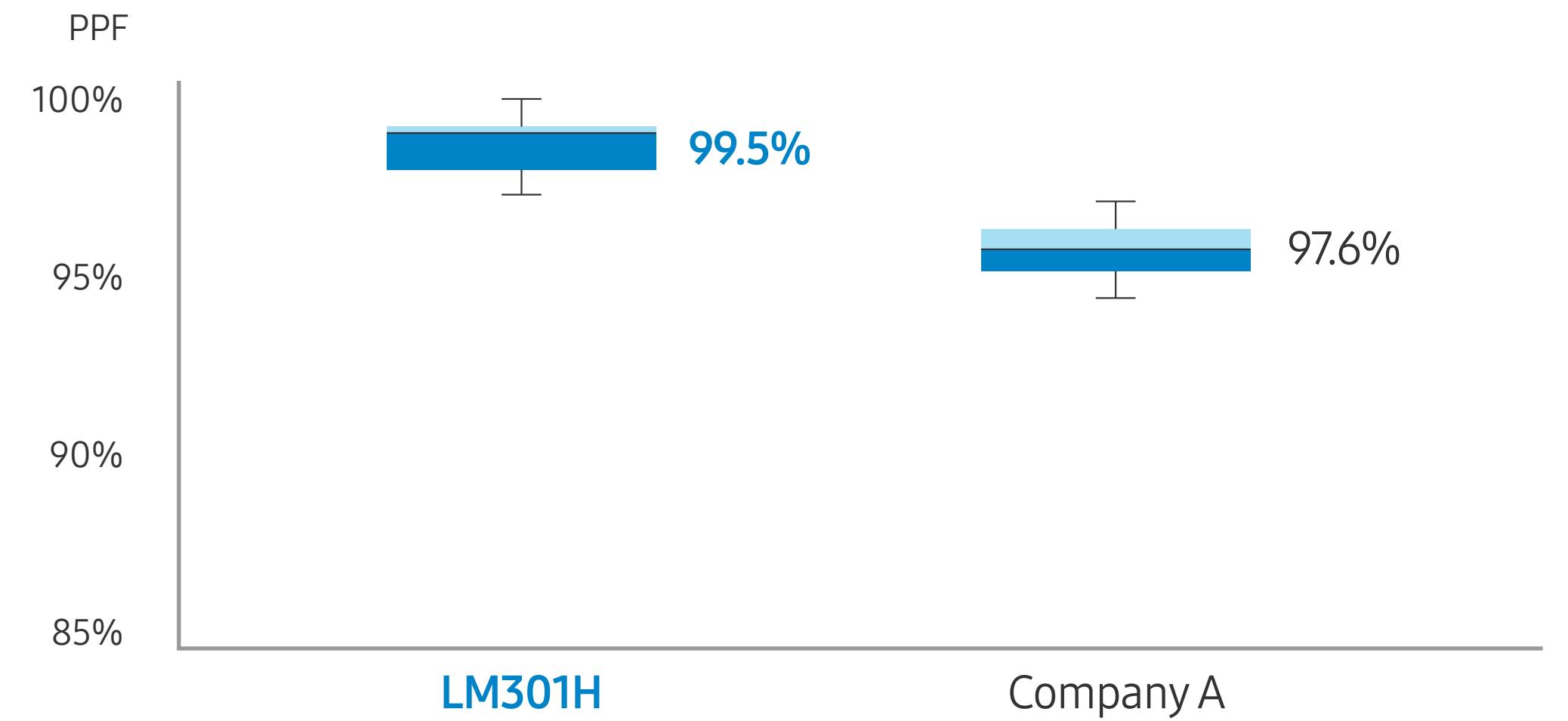
## ■ 재배환경에 최적화된 성능을 유지할 수 있는 강한 내구성

### 내황 테스트



H<sub>2</sub>S 15ppm, 25°C / 75% humidity for 504hrs  
※ IEC Pub.68-2-43

### 고온내습 테스트

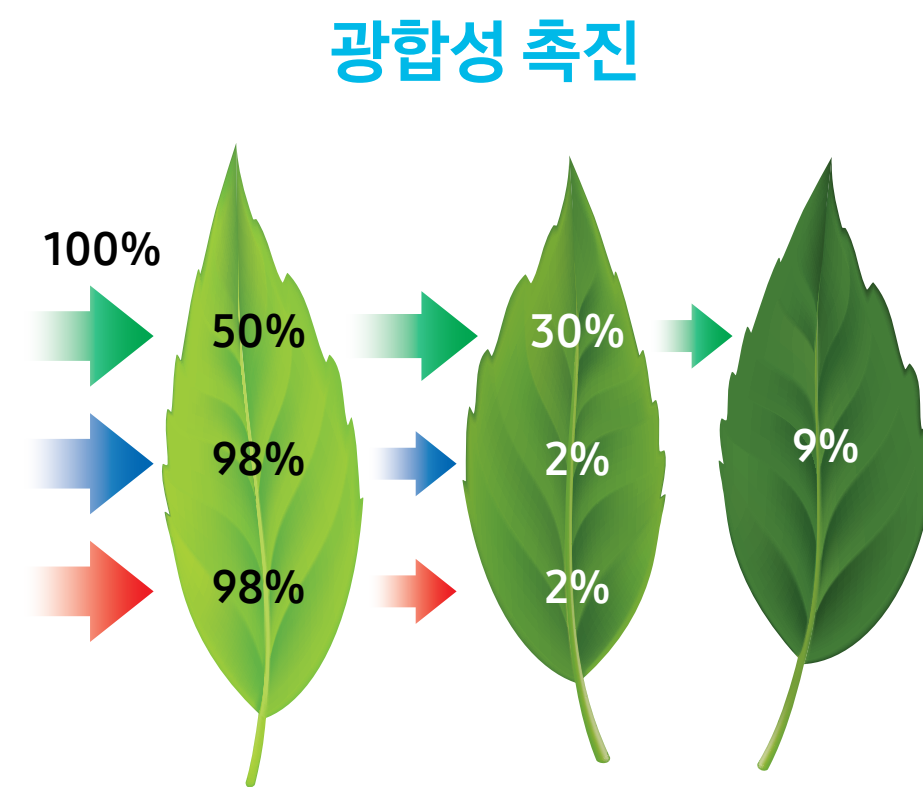


Operation in 85°C / 85% humidity for 1,000hrs

## 업계 최고 수준의 다양한 LED 솔루션

	미드파워 White 65mA 25°C CRI80+ 5000K			하이파워 Red 350mA 25°C		
	SAMSUNG LM301H	Company A	Remark	SAMSUNG LH351H Red	Company B	Remark
사이즈 (mm <sup>2</sup> )	3.0 x 3.0	3.0 x 3.0	-	3.5 x 3.5	3.0 x 3.0	-
PPF (μmol/s)	0.56	0.51	+10%	2.63	2.62	-
PPF/W (μmol/J)	3.10	2.86	+8%	3.73	3.72	-

## 광합성과 영양분은 촉진하고 병충해는 예방하는 조명



1. Kozai, Ohmsya Pub P227. (2015) / 2. Jindong, Plant Cell Physiol. (1998)



1. Kudo, SRI Res Rep. (2009) / 2. Kudo, Horti Res. (2013) / 3. Kudo, SRI Res Rep. (2010)



1. Tao, J. Biochem Biotech. (2017)



## 스펙트럼 비교 실험

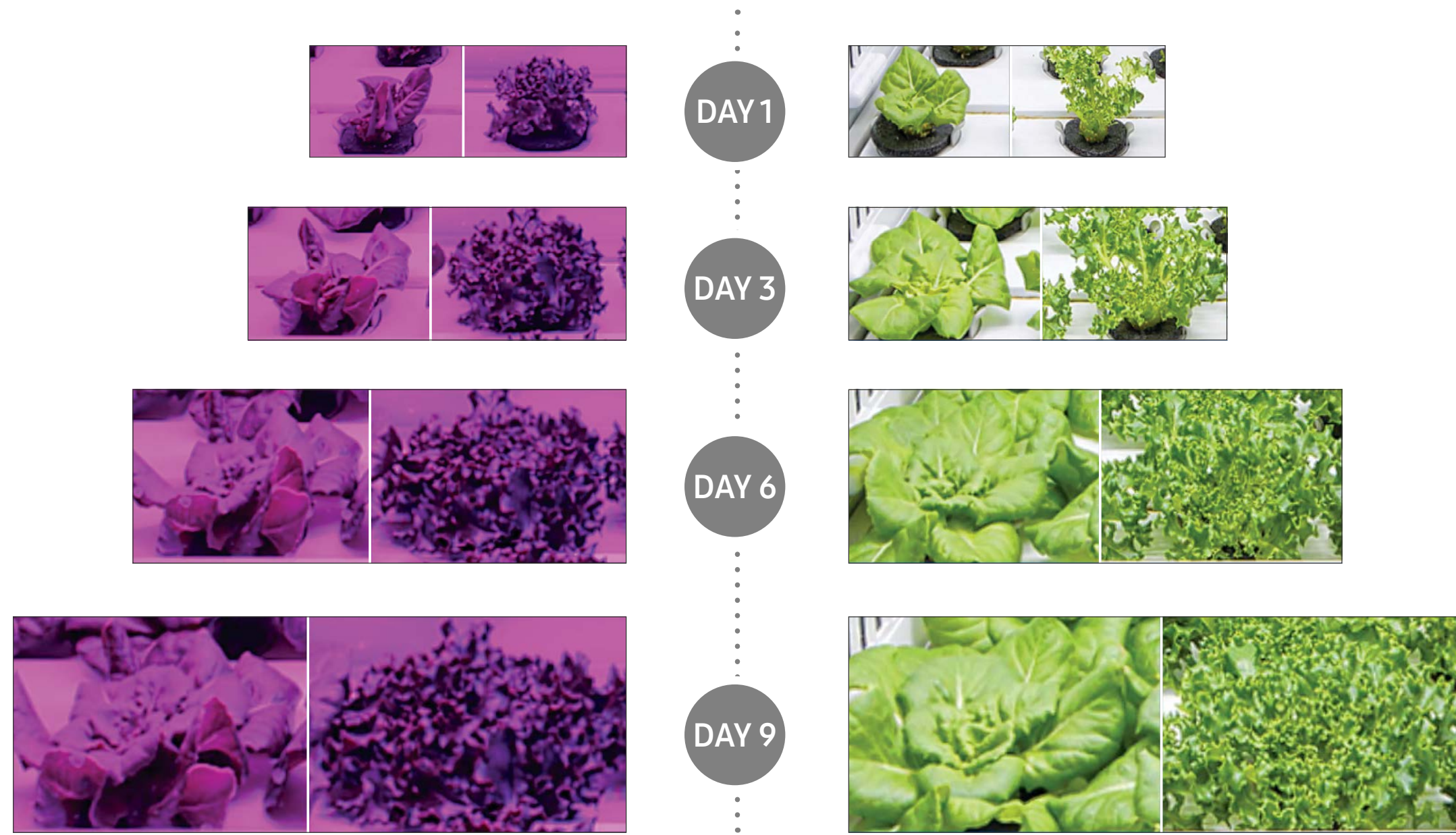
PLAY VIDEO ▶



- 식물: 엽채류 작물 2종 (Butterhead Lettuce, Oak Leaf)
- 환경: 24°C, RH 70%, On/Off=16/8hrs, 수경재배
- 실험기간: 10일
- 변수: 동일 PPF 내 다른 조명 스펙트럼 (단일 vs. 풀)

### Narrow Spectrum

### Full Spectrum



※ Experiment was repeated 3 times with different batches for reproducibility

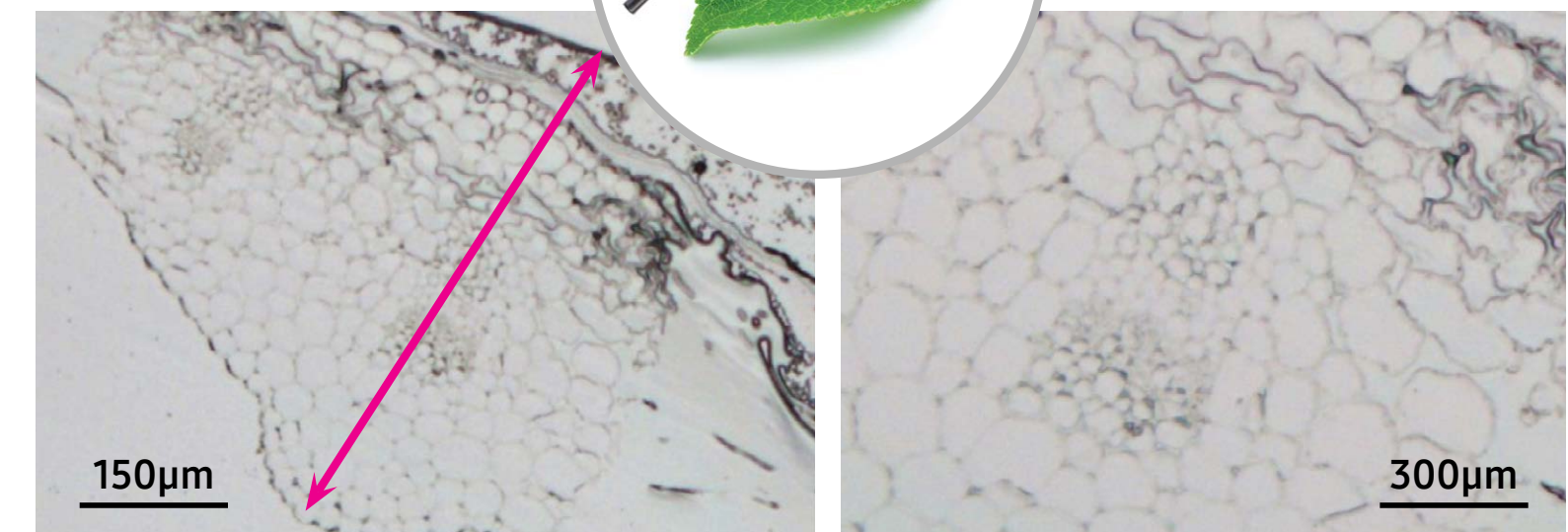
## 풀스펙트럼에서 더욱 건강하게 성장

- 단일 스펙트럼과 풀스펙트럼에서 자란 잎사귀의 단면을 비교
- 풀스펙트럼으로 키운 작물이 더 두껍고 균형있는 조직 구조를 나타냄

### Narrow Spectrum



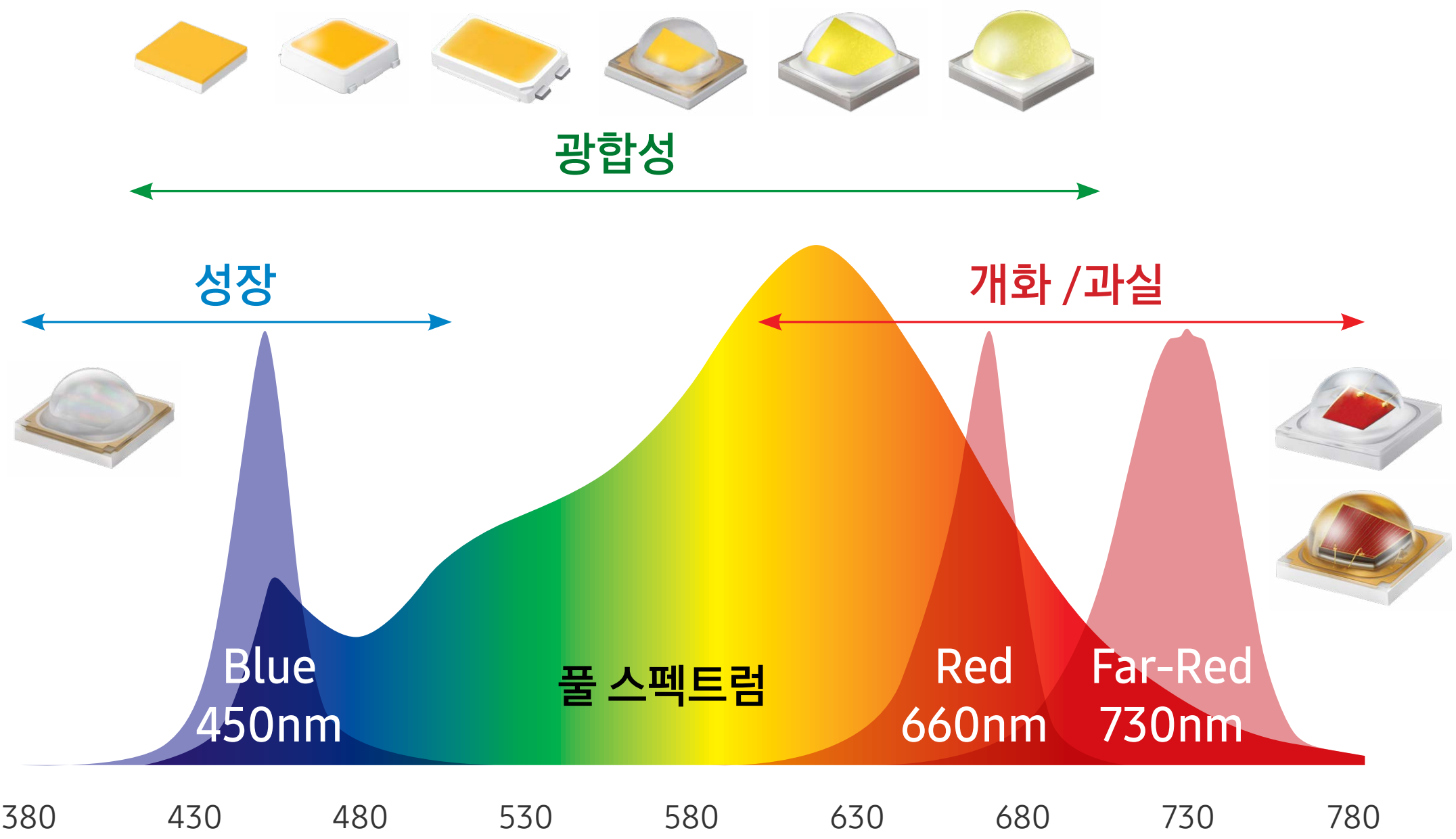
### Full Spectrum



※ Acknowledgement: Prof. Chun at Seoul National Univ.



## 미드파워부터 하이파워, 백색부터 단색까지 아우르는 폭 넓은 라인업



## 고객 맞춤형 제품 설계를 위한 스펙트럼 시뮬레이션 툴



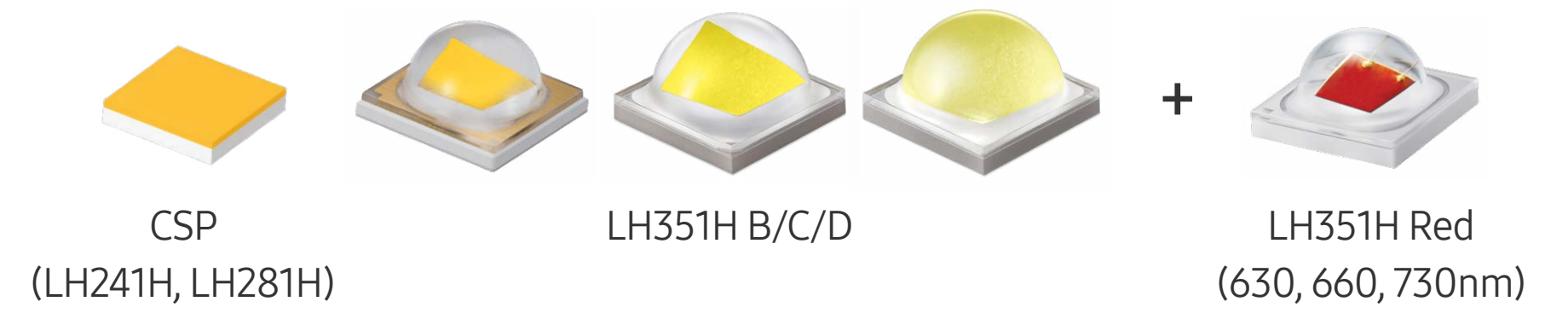


## 수직 재배



\* Crop: Lettuce, Herb → Short Size, Short Life Cycle

## 온실 재배



\* Crop: Tomato, Pepper, Cucumber → Tall Size



# Product Line-up

## I 백색 LED (미드파워)

업계 최고 광효율 및 신뢰성 제공

### LM301H



- World's best efficacy
- Anti-sulfurization (with flip-chip technology)

@65mA, 25°C, 5000K, CRI80+

Rank	Color	PPF (μmol/s)	PPF/W (μmol/J)	Footprint (mm <sup>2</sup> )
SL	White	0.56	3.10	3.0 × 3.0

### LM301H ONE



- Optimized spectrum for leafy greens
- Anti-sulfurization (with flip-chip technology)

@65mA, 25°C, 3400K, CRI70+

Rank	Color	PPF (μmol/s)	PPF/W (μmol/J)	Footprint (mm <sup>2</sup> )
S0	White	0.49	2.75	3.0 × 3.0

### LM561H



- Balanced performance/cost
- Anti-sulfurization (with protection coating)

@65mA, 25°C, 5000K, CRI80+

Rank	Color	PPF (μmol/s)	PPF/W (μmol/J)	Footprint (mm <sup>2</sup> )
S6	White	0.51	2.84	5.6 × 3.0

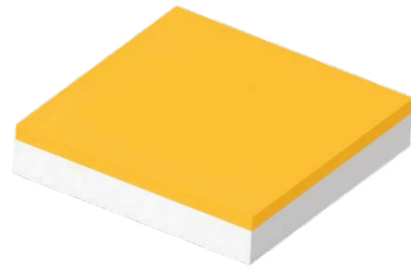


# Product Line-up

## I 백색 LED (하이파워)

업계에서 입증된 성능기반 하이파워 백색 LED

### LH241H



- Compact design for small LES module
- Viewing angle: 120°
- Thermal resistance: 2.0K/W

@350mA, 25°C, 5000K, CRI70+

Rank	Color	PPF (μmol/s)	PPF/W (μmol/J)	Footprint (mm <sup>2</sup> )
R1	White	2.51	2.52	2.4 x 2.4

### LH281H



- Compact design for small LES module
- Viewing angle: 120°
- Thermal resistance: 2.0K/W

@350mA, 25°C, 5000K, CRI70+

Rank	Color	PPF (μmol/s)	PPF/W (μmol/J)	Footprint (mm <sup>2</sup> )
SB	White	2.59	2.65	2.8 x 2.8

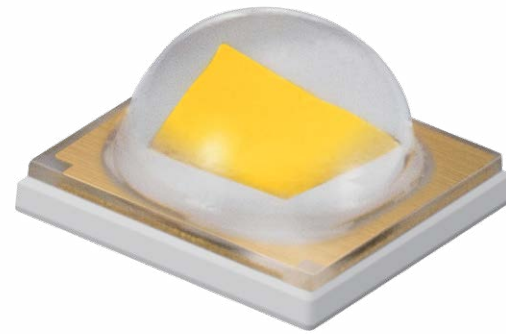


# Product Line-up

## I 백색 LED (하이파워)

업계에서 입증된 성능기반 하이파워 백색 LED

### LH351H-B

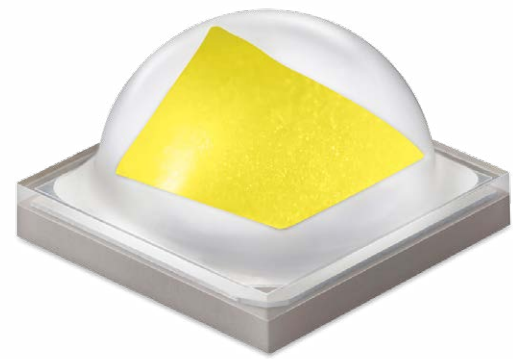


- Viewing angle: 120°
- Thermal resistance: 4.2K/W

@350mA, 25°C, 5000K, CRI70+

Rank	Color	PPF (μmol/s)	PPF/W (μmol/J)	Footprint (mm <sup>2</sup> )
Q1	White	2.48	2.51	3.5 × 3.5

### LH351H-C



- Viewing angle: 130°
- Thermal resistance: 3.0K/W

@350mA, 25°C, 5000K, CRI70+

Rank	Color	PPF (μmol/s)	PPF/W (μmol/J)	Footprint (mm <sup>2</sup> )
RB	White	2.56	2.60	3.5 × 3.5

### LH351H-D



- Viewing angle: 130°
- Thermal resistance: 2.2K/W

@350mA, 25°C, 5000K, CRI70+

Rank	Color	PPF (μmol/s)	PPF/W (μmol/J)	Footprint (mm <sup>2</sup> )
Y2	White	2.58	2.69	3.5 × 3.5



# Product Line-up

## I 단색 LED (하이파워)

업계에서 입증된 성능기반 하이파워 단색 LED

### LH351H Blue (450nm)



- Viewing angle: 130°
- Thermal resistance: 4.0K/W

@350mA, 25°C

Color	PPF ( $\mu\text{mol/s}$ )	PPF/W ( $\mu\text{mol/J}$ )	Footprint ( $\text{mm}^2$ )
Blue	2.80	2.80	3.5 × 3.5

### LH351H Red (630nm)



- Viewing angle: 120°
- Thermal resistance: 4.0K/W

@350mA, 25°C

Color	PPF ( $\mu\text{mol/s}$ )	PPF/W ( $\mu\text{mol/J}$ )	Footprint ( $\text{mm}^2$ )
Red	1.57	2.14	3.5 × 3.5



# Product Line-up

## I 단색 LED (하이파워)

업계에서 입증된 성능기반 하이파워 단색 LED

### LH351H Deep Red (660nm)

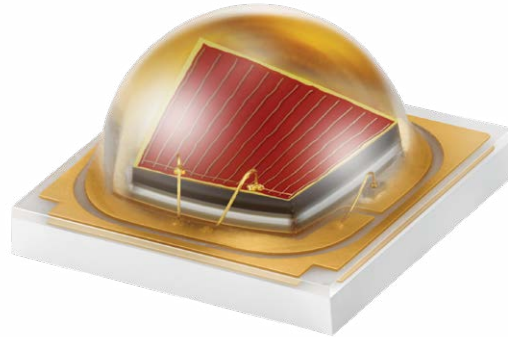


- Viewing angle: 120°
- Thermal resistance: 2.5K/W

@350mA, 25°C

Color	PPF (μmol/s)	PPF/W (μmol/J)	Footprint (mm <sup>2</sup> )
Deep Red	2.32	3.12	3.5 × 3.5
Deep Red	2.4	3.11	3.5 × 3.5

### LH351H Deep Red (660nm) V2



- Viewing angle: 130°
- Thermal resistance: 3.0K/W

@350mA, 25°C

Color	PPF (μmol/s)	PPF/W (μmol/J)	Footprint (mm <sup>2</sup> )
Deep Red	2.63	3.73	3.5 × 3.5

### LH351H Far Red (730nm)



- Viewing angle: 120°
- Thermal resistance: 3.9K/W

@350mA, 25°C

Color	* BPF (μmol/s)	* BPF/W (μmol/J)	Footprint (mm <sup>2</sup> )
Far Red	1.96	2.91	3.5 × 3.5
Far Red	2.07	3.1	3.5 × 3.5

\* Biologically-active Photon Flux

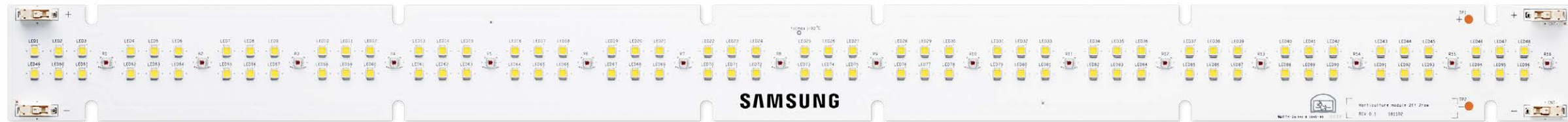
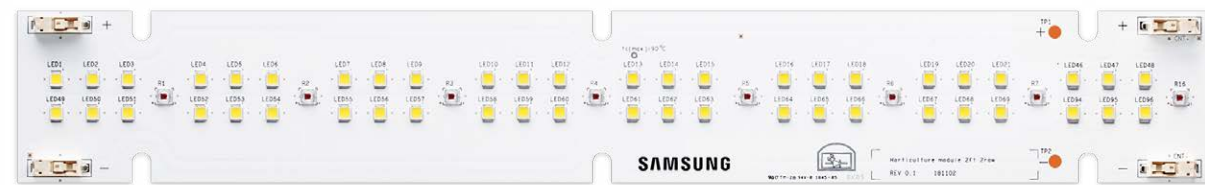


# Product Line-up

## I Module

업계 최고 광효율 및 신뢰성 제공

### Horticulture LED Module



※ Conformal coating is optional

Item	LED type	CCT	Flux	Efficacy	PPF	PPF/W	If	Vf	Watt	Tp
Unit	-	K	lm	lm/W	μmol/s	μmol/J	mA	V	W	°C
1ft	White + Red	5390	4110	159	70.9	2.74	1200	21.5	25.8	25
2ft		5390	8220	159	141.8	2.74	1200	43.1	51.7	25