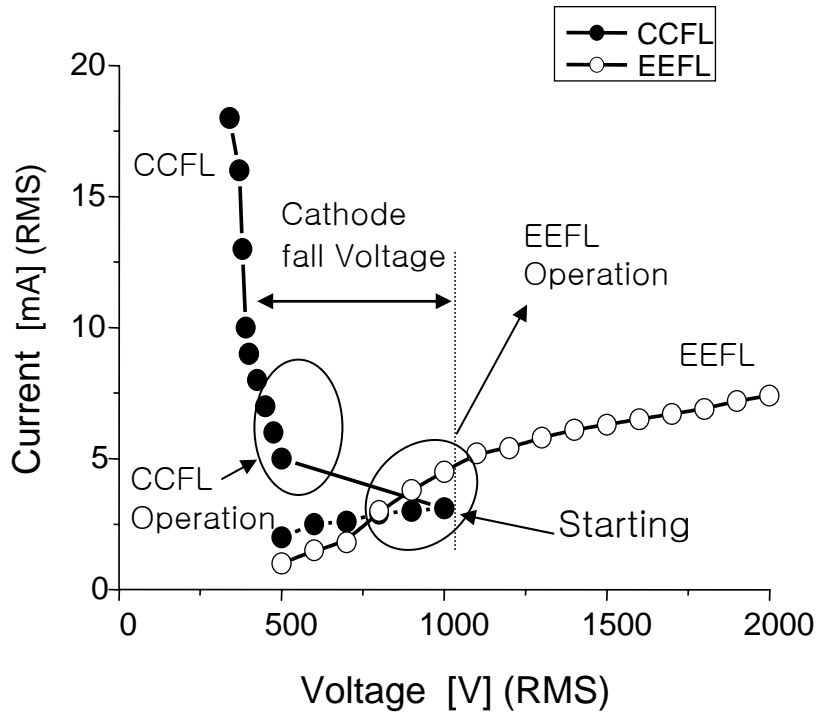


# **EEFL-Backlight Technology**

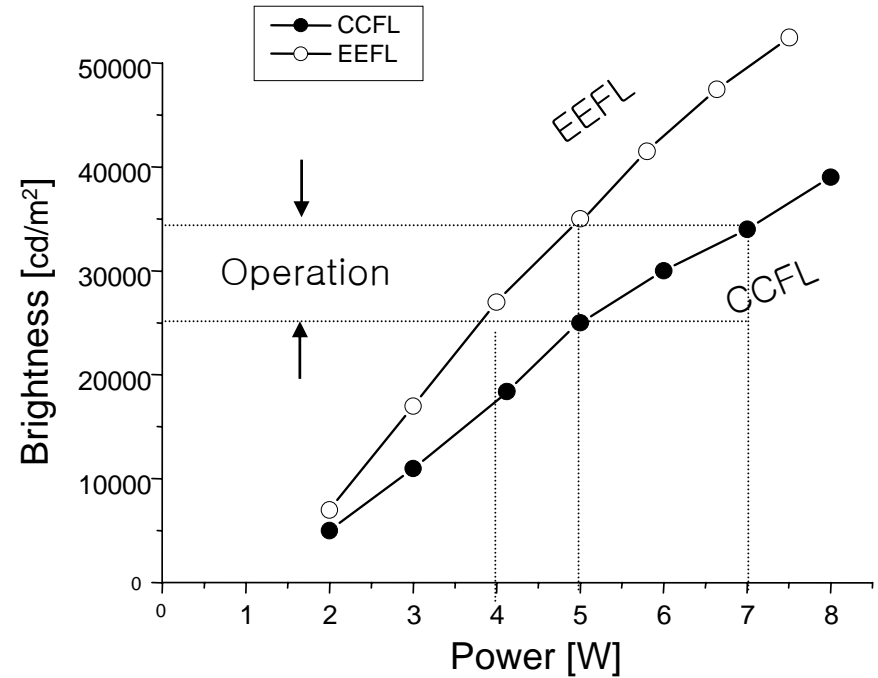
**(End-Cap Type External Electrode Fluorescent Lamp)**

KDT m&s Co.,Ltd., Korea

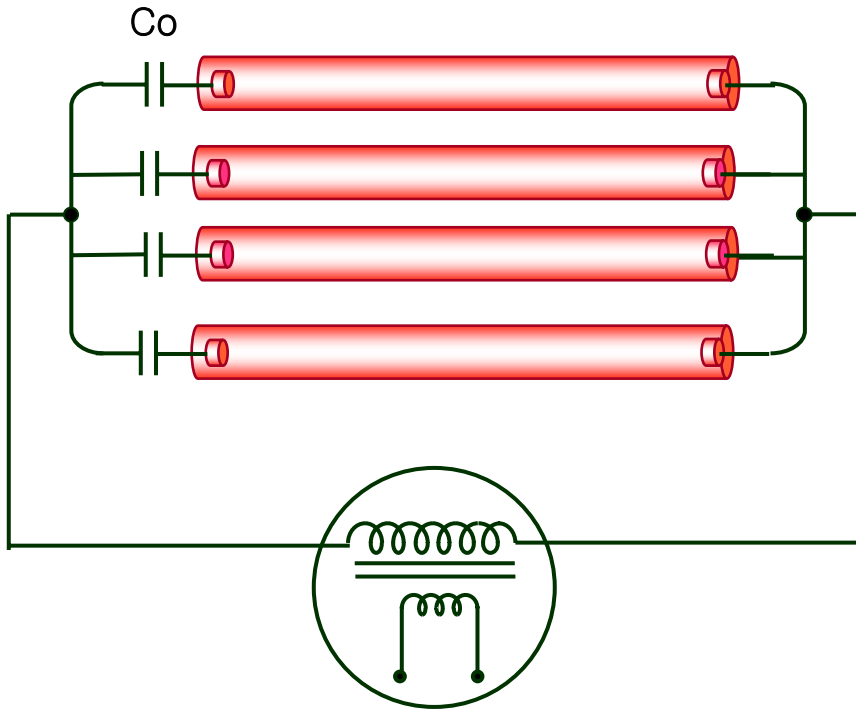
## I-V Characteristics



## 19" Lamp (2.6 mm / 393 mm)

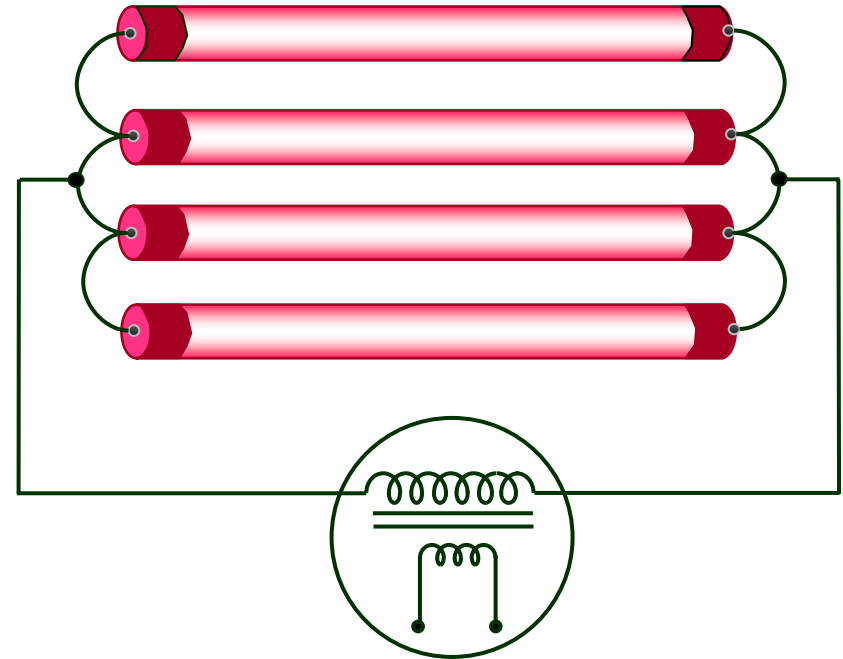


## ▶ Multi-CCFLs



- $C_o$  : Ballast Capacitor for the Uniformity

## ▶ Multi-EEFLs



- Good Uniformity

## ► Key Issues ;

1<sup>st</sup>. Switching Inverter generating **AC-Square Pulses**

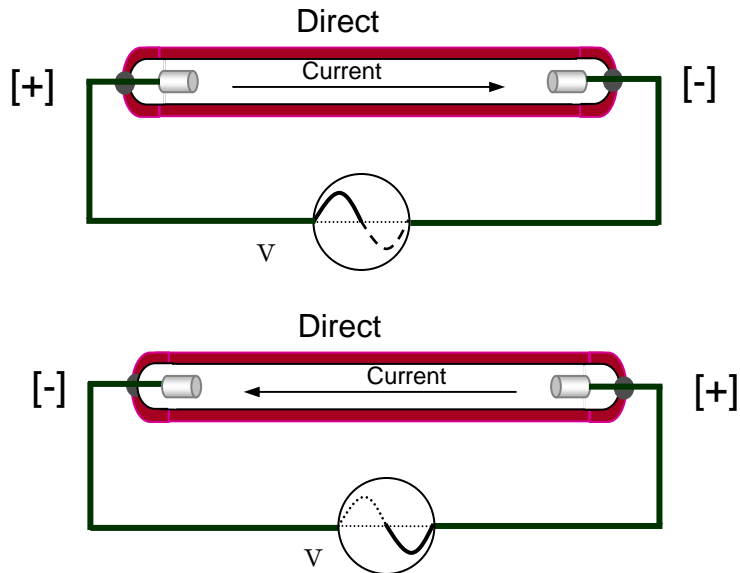
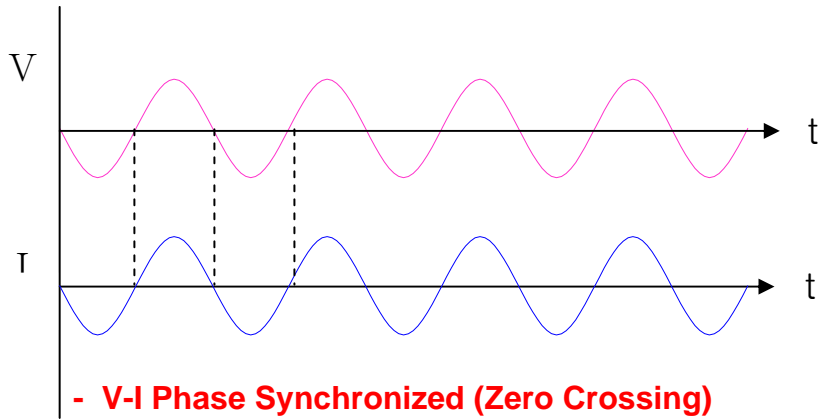
2<sup>nd</sup>. Driving Methods of **Self-Discharge Synchronizing**

3<sup>rd</sup>. New External Electrode Formation Scheme

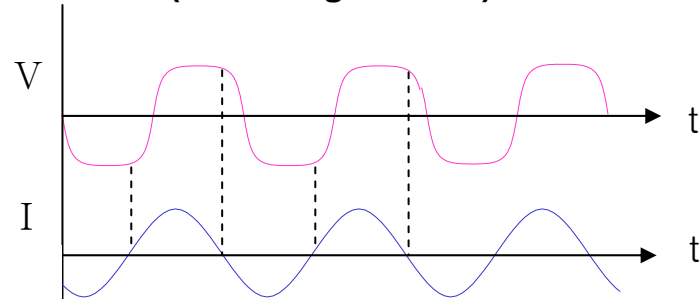
: **Metal-Glass Melt-Bonding Technology** provides  
High Capacitance

# Lamp Operation

## CCFL (LC-Resonance Inverter)

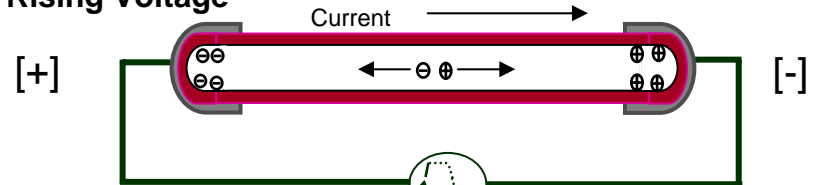


## EEFL (Switching Inverter)

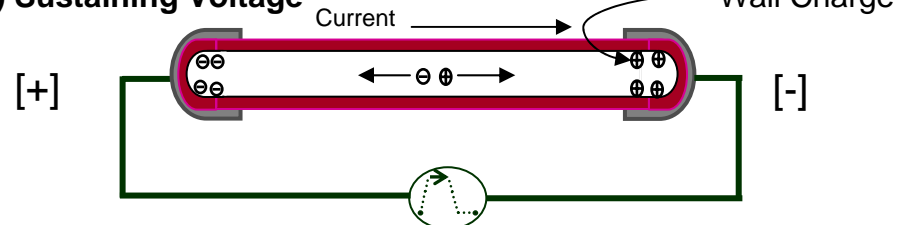


- Self-Discharge Synchronized for high Efficiency

### (i) Rising Voltage



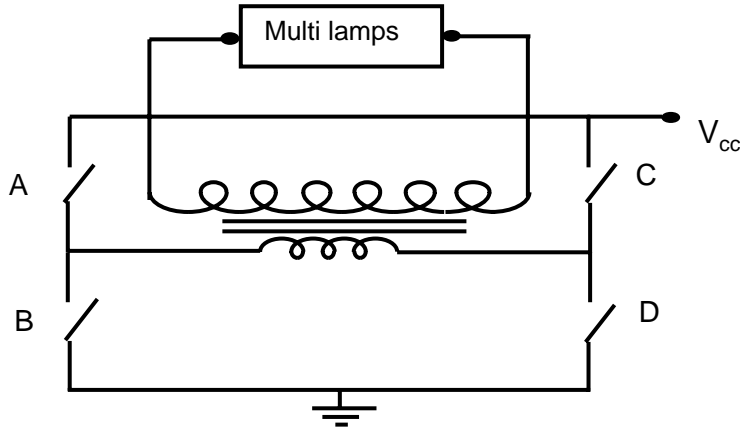
### (ii) Sustaining Voltage



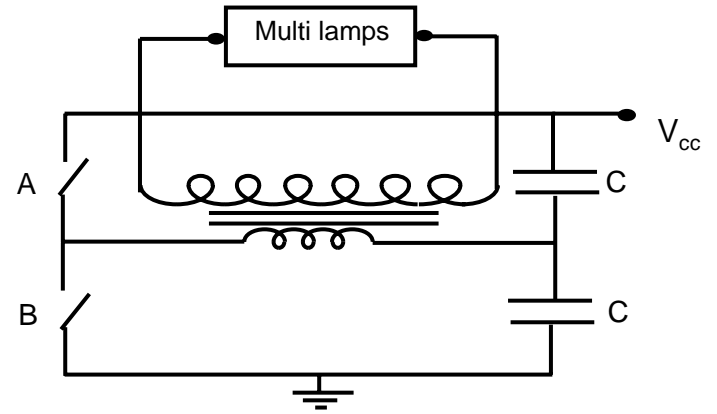
### (iii) Falling Voltage



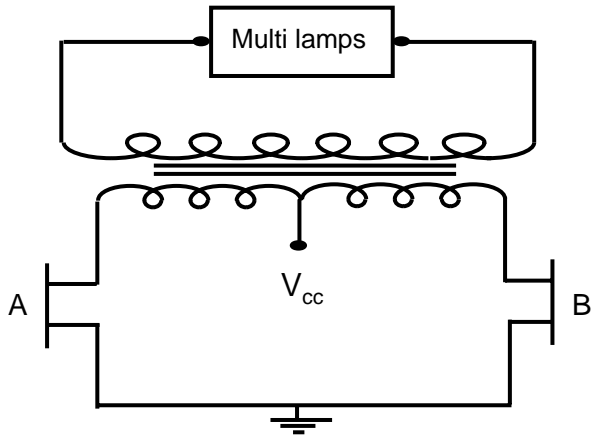
## • Full-Bridge Circuit



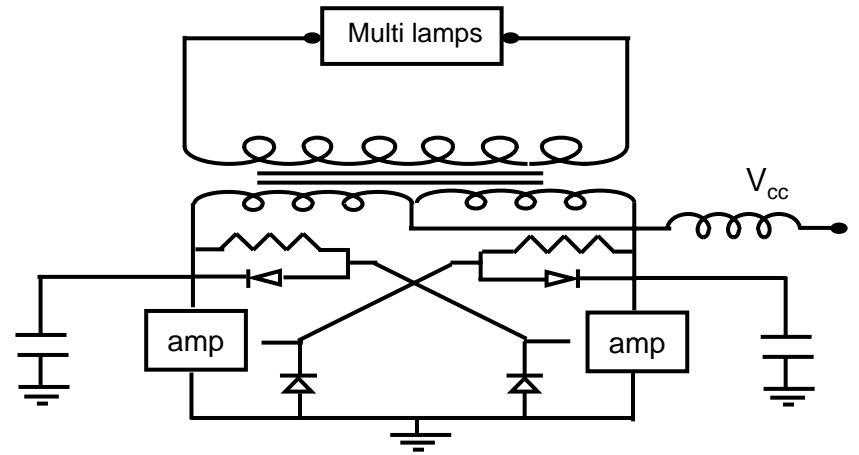
## • Half - Bridge Circuit



## • Push-Pull Circuit

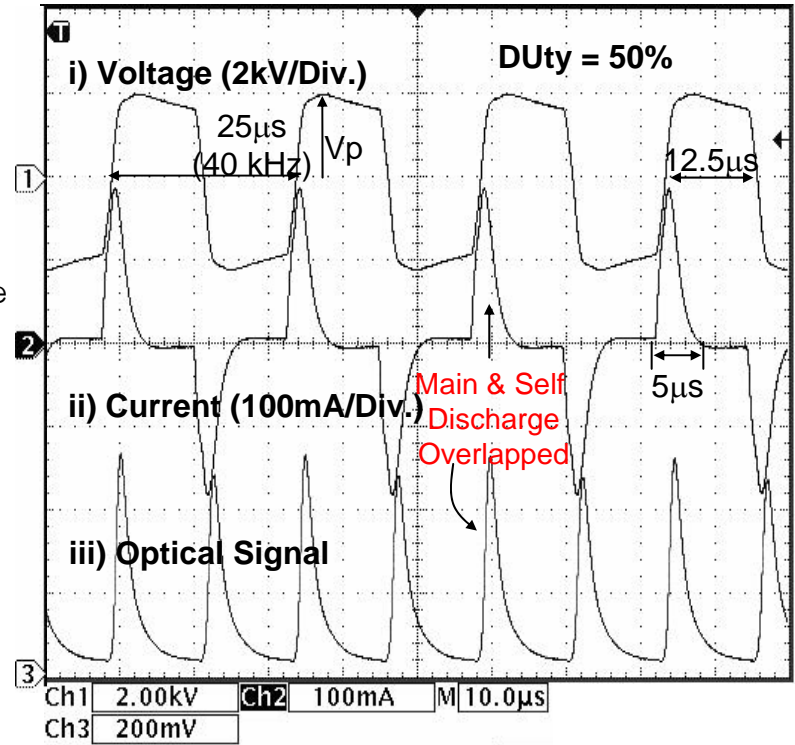
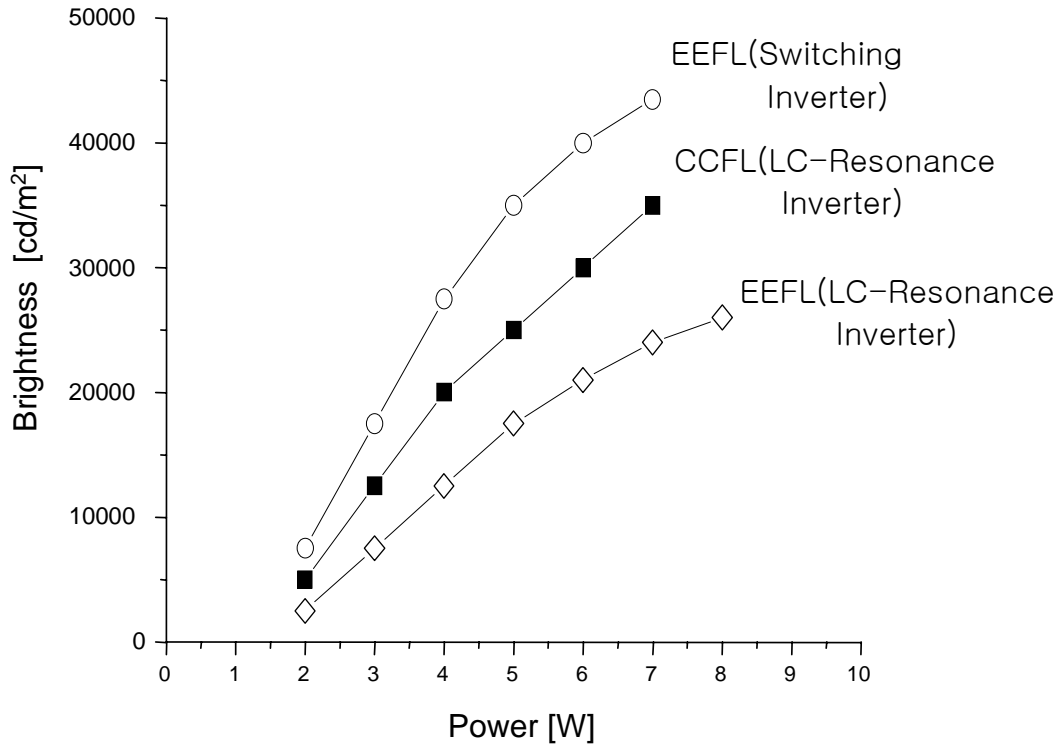


## • AStable Multi - Vibrator



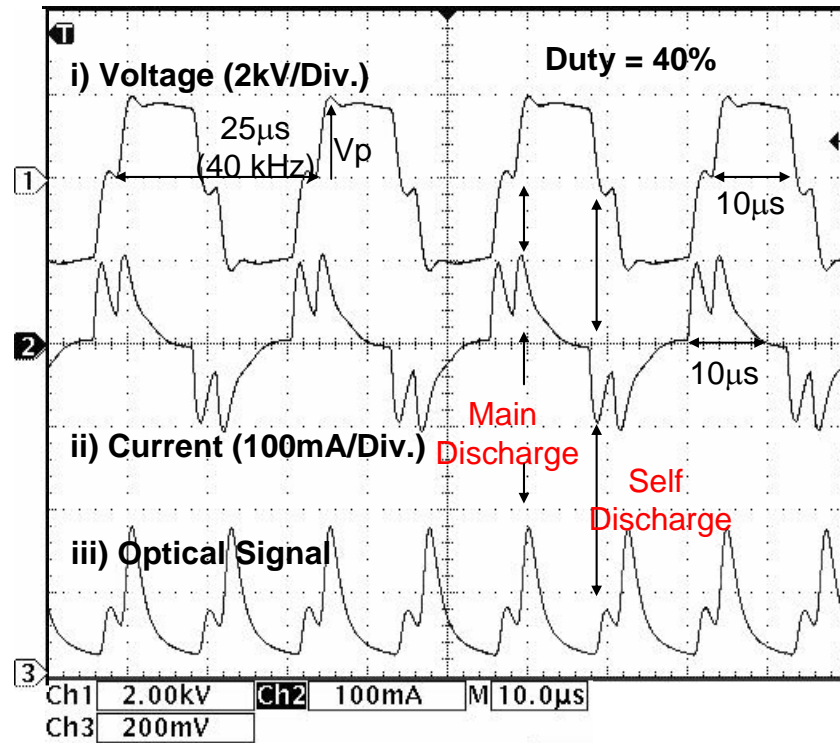
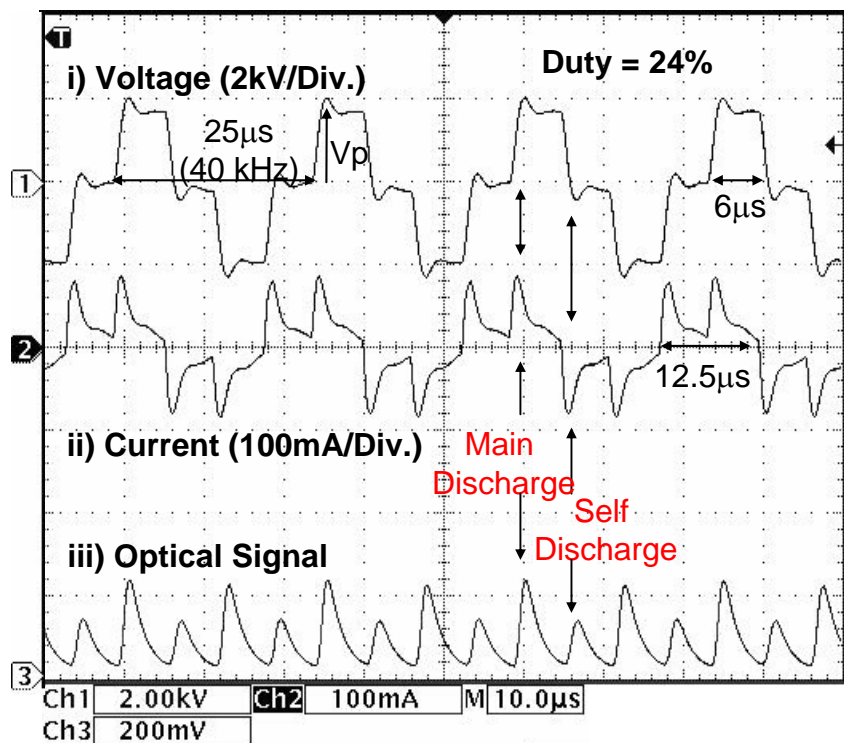
- 19" Lamp

- EEFL(Switching Inverter)



# EEFL Driven by a Switching Inverter

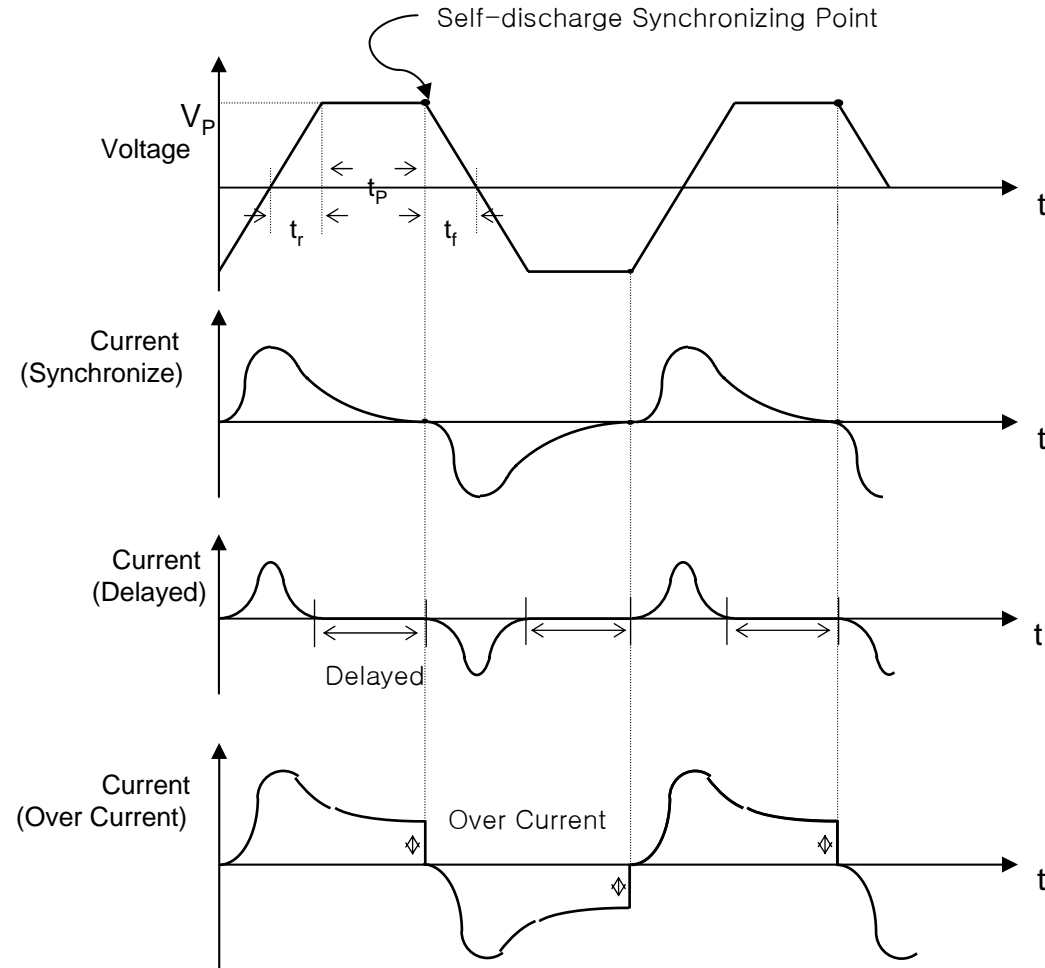
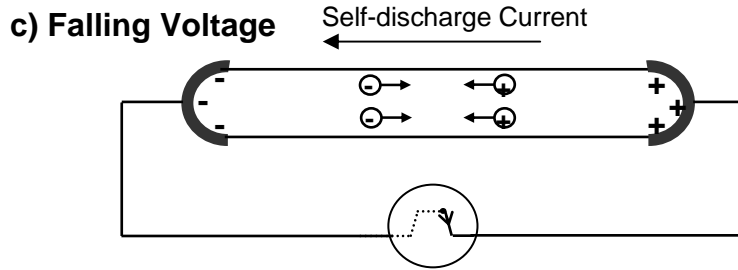
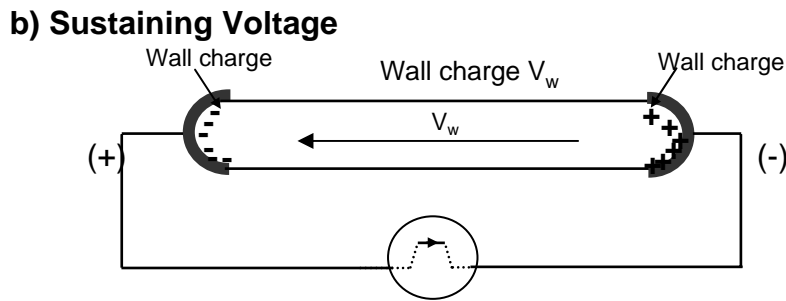
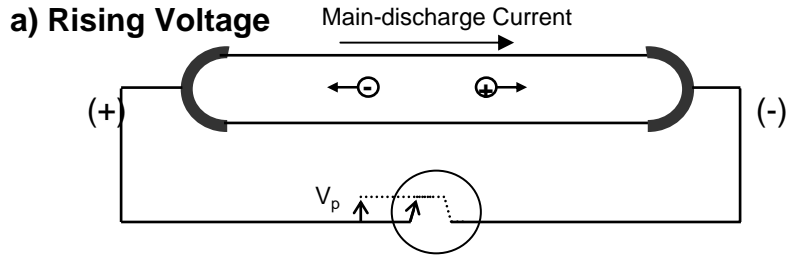
Confidential





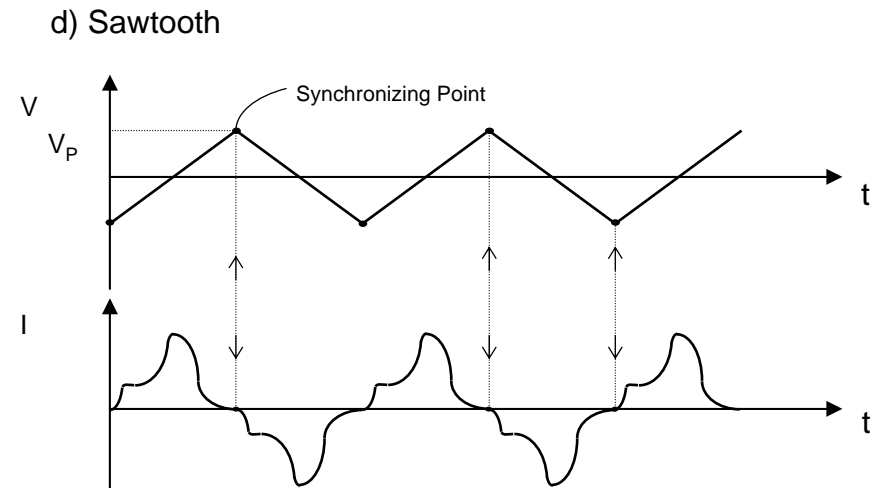
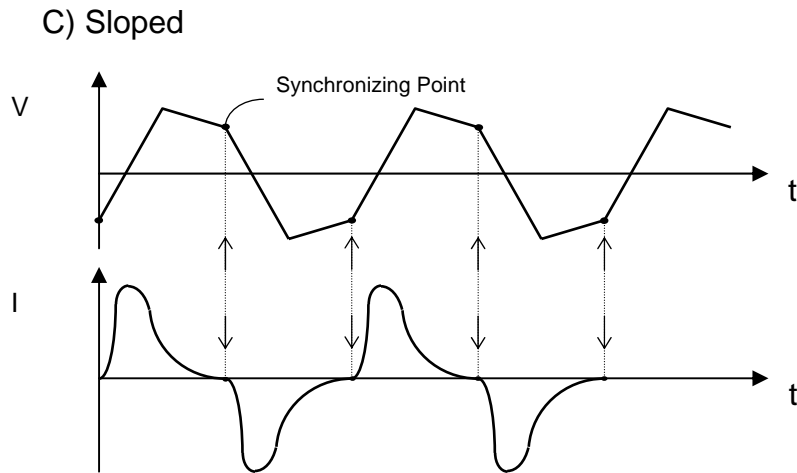
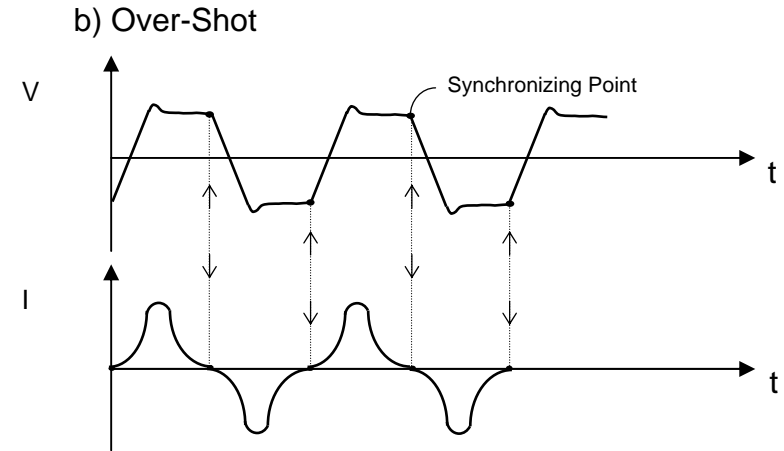
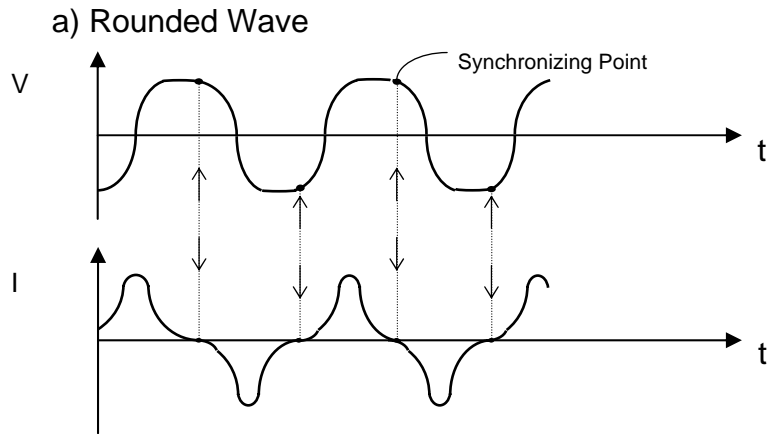
# EEFL Driven by a Switching Inverter

Confidential

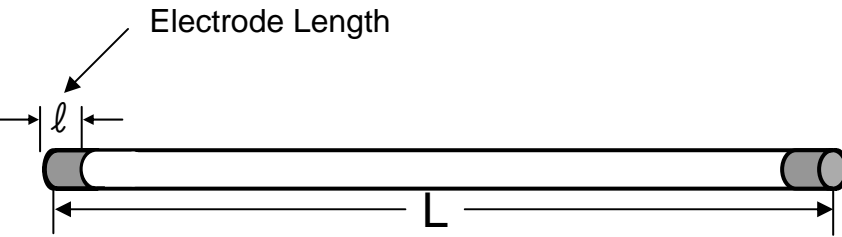


# EEFL Driven by a Switching Inverter

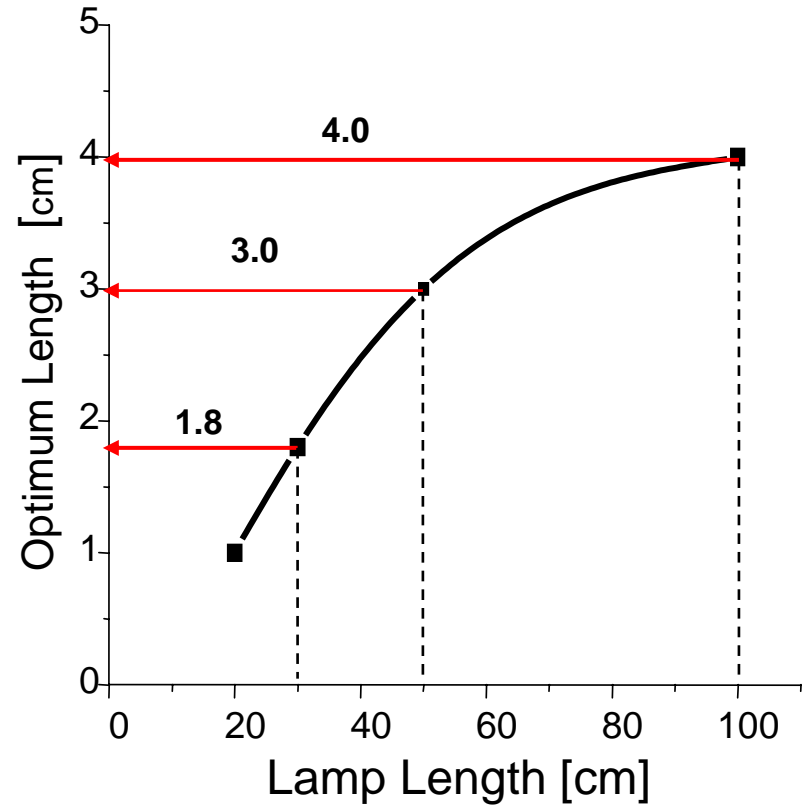
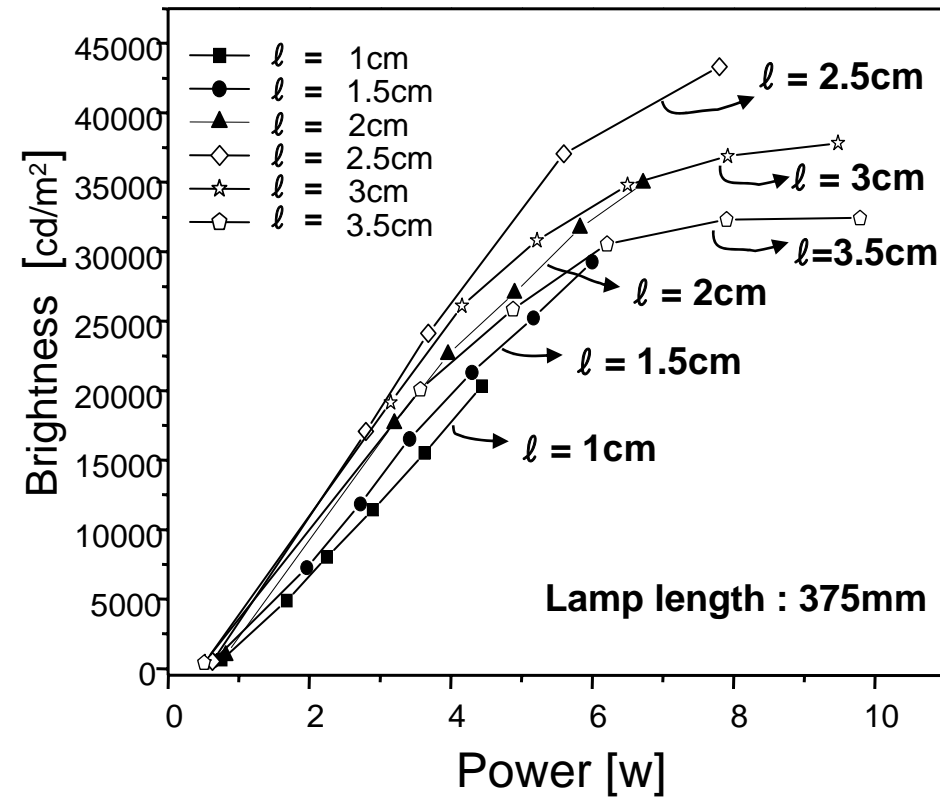
## Self-Discharge Synchronized Wave Formulas



# EEFL Electrode Structure

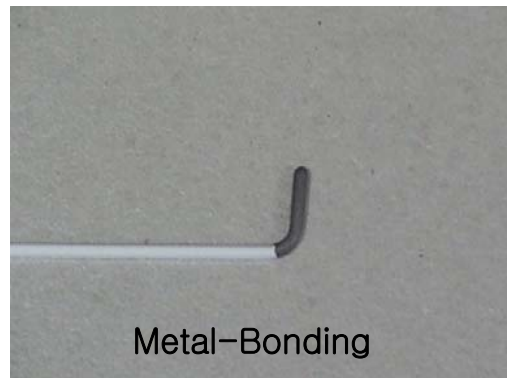
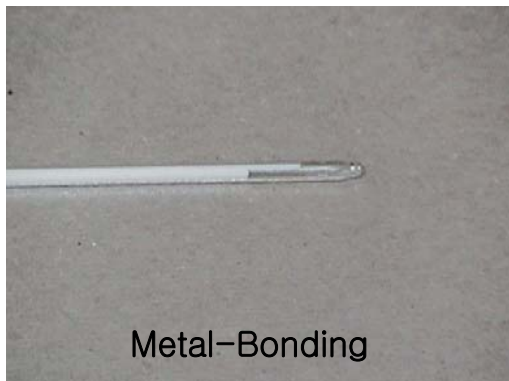
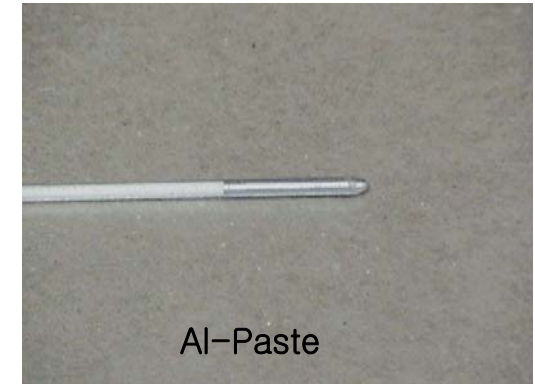
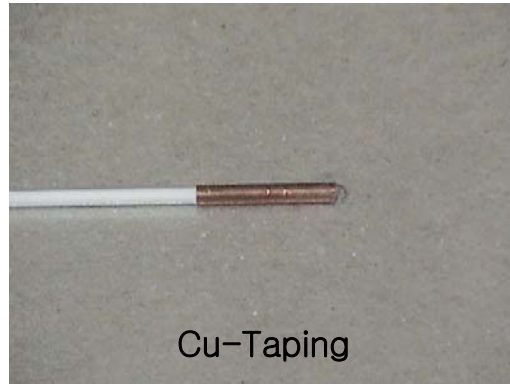


## • Optimum Electrode Length

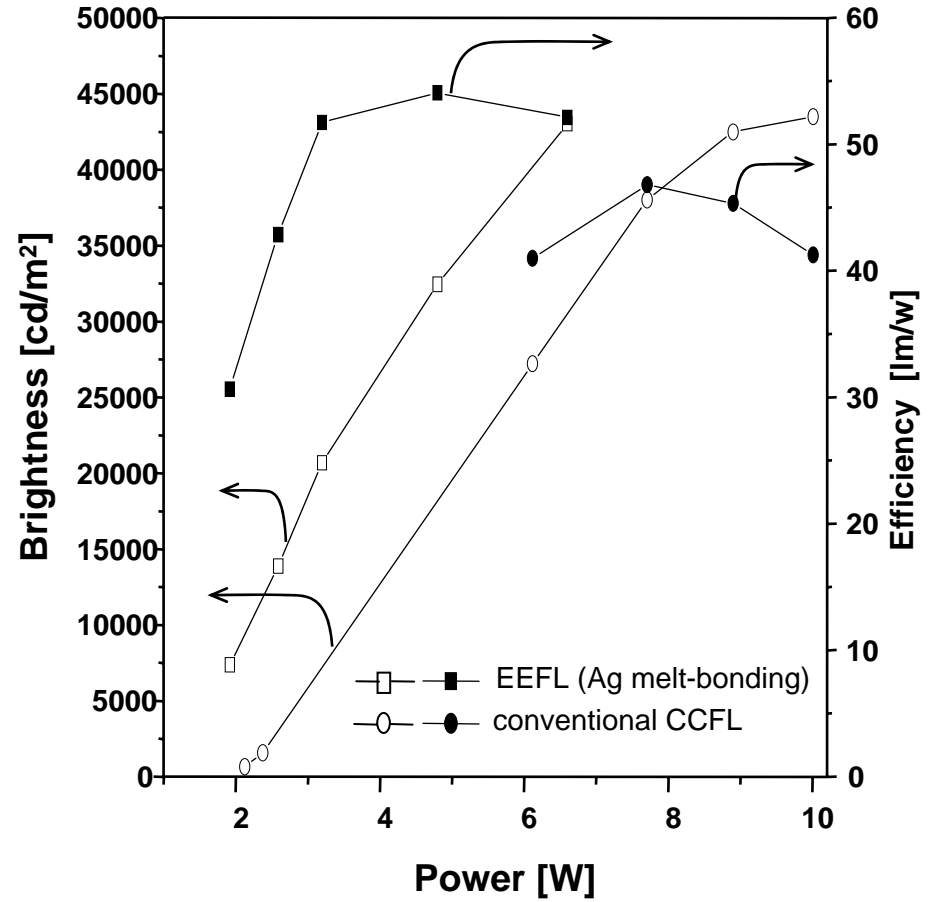
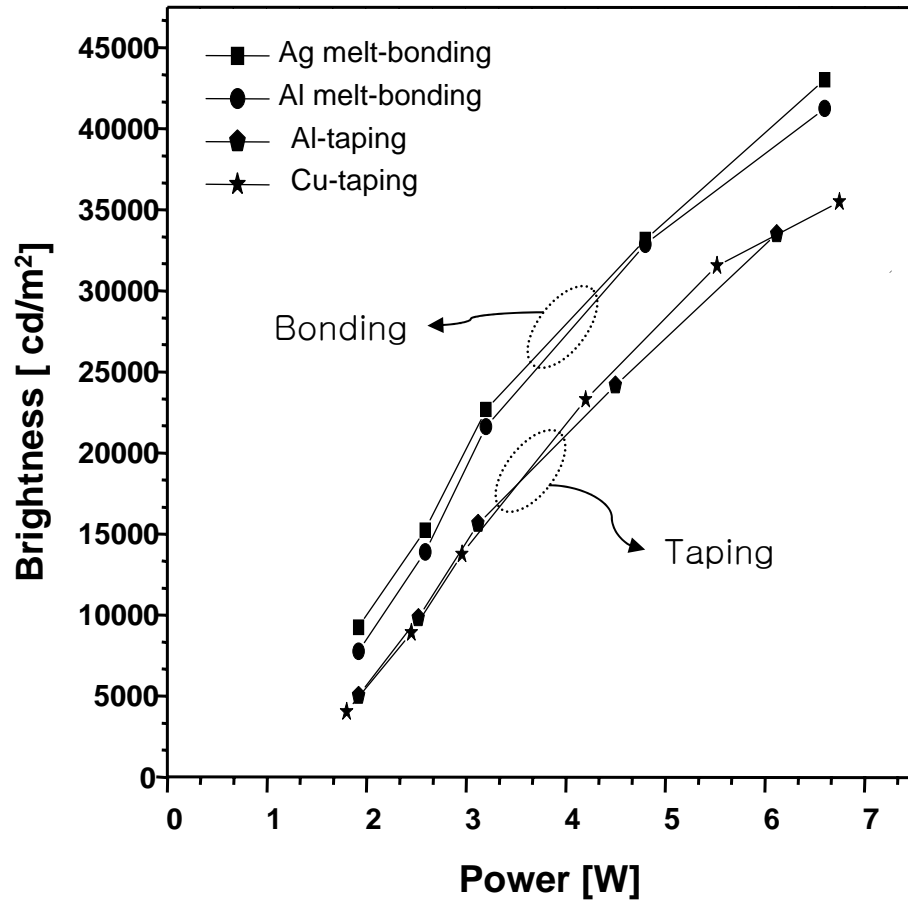


## ▶ Electrode Formation Methods

- 1) Metal Cap ( Copper Cap )
- 2) Metal Foil Taping
- 3) Metal Plating
- 4) Metal-Glass Melt-Bonding

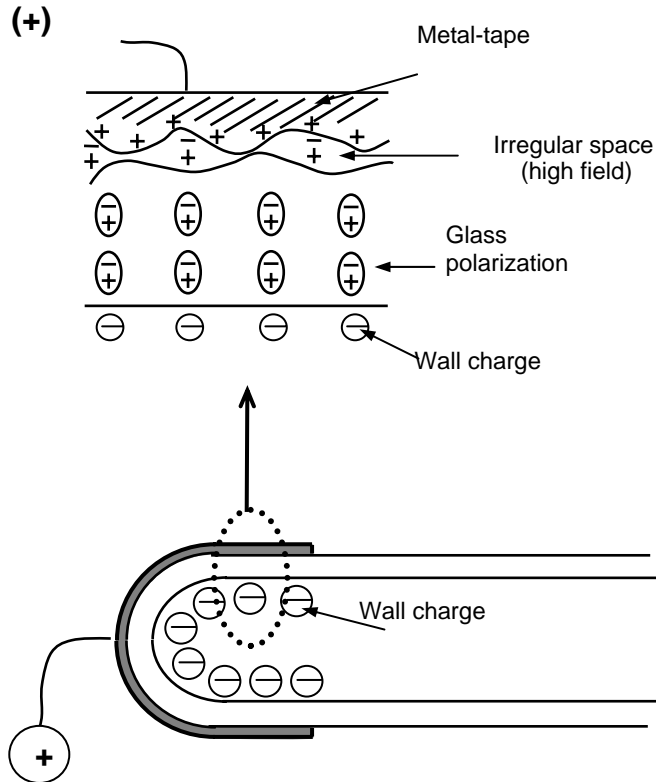


# EEFL Electrode Structure

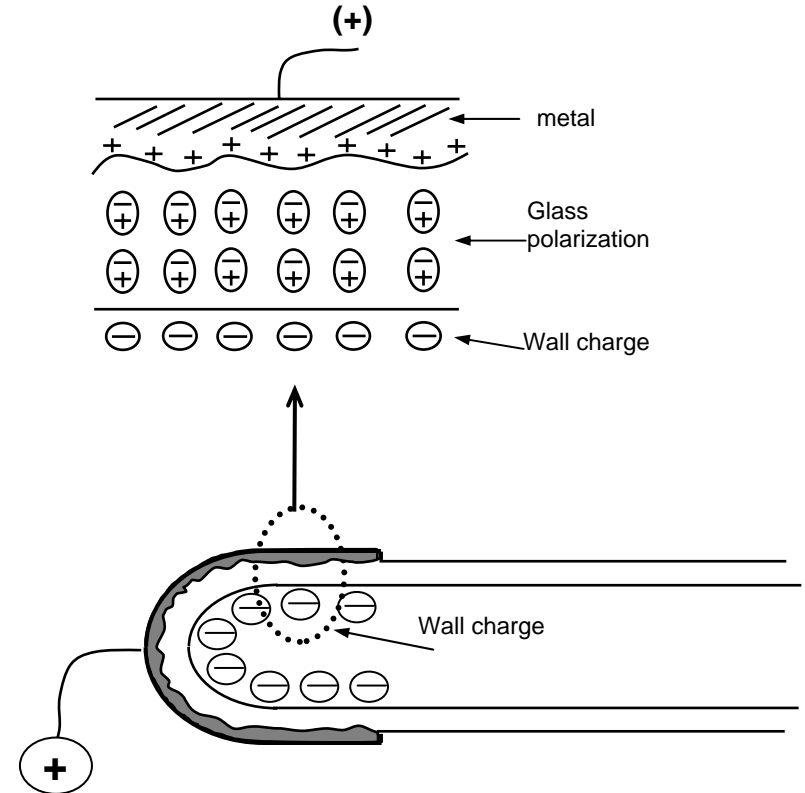


# Metal-Glass Melt-Bonding Technology

- **Metal-taping  
(Low Capacitance)**



- **Metal-glass melt-bonding  
(High Capacitance)**



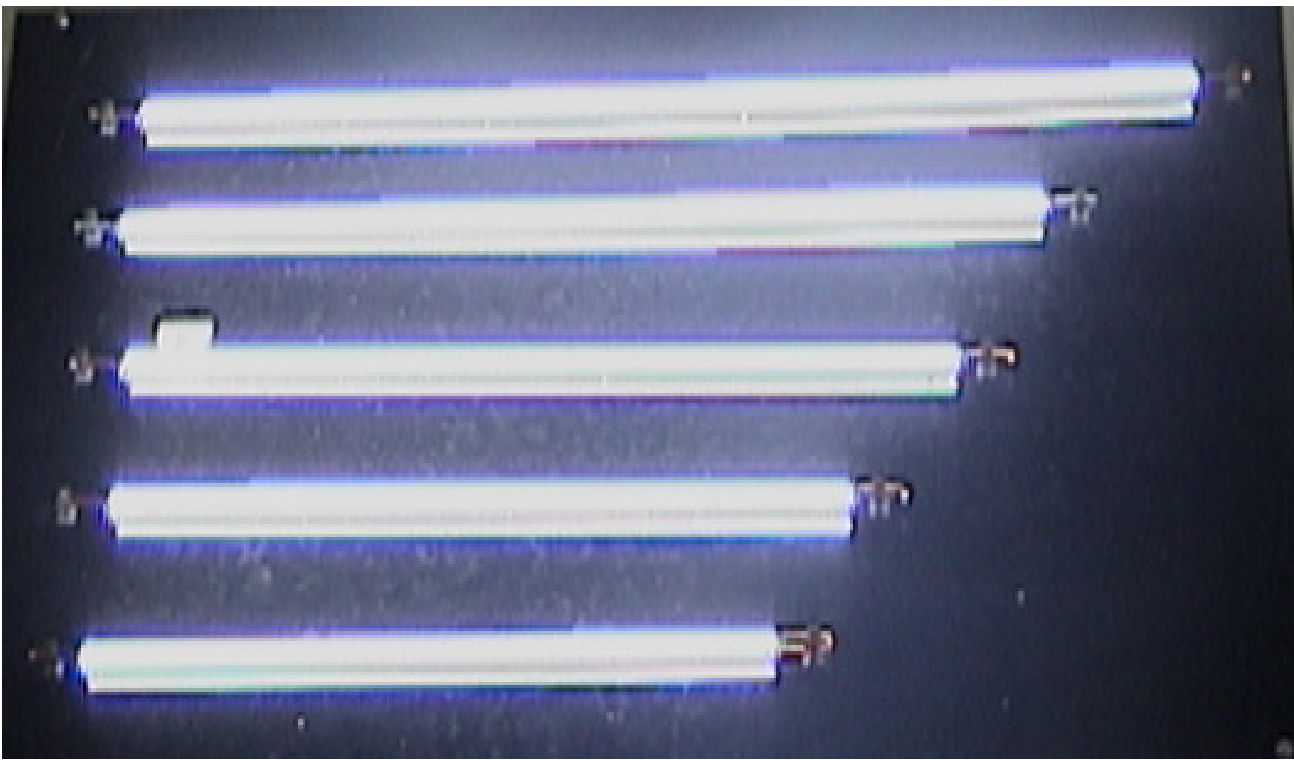
## -Color EEFL Lamps







# Various EEFL-Lamps



450 mm

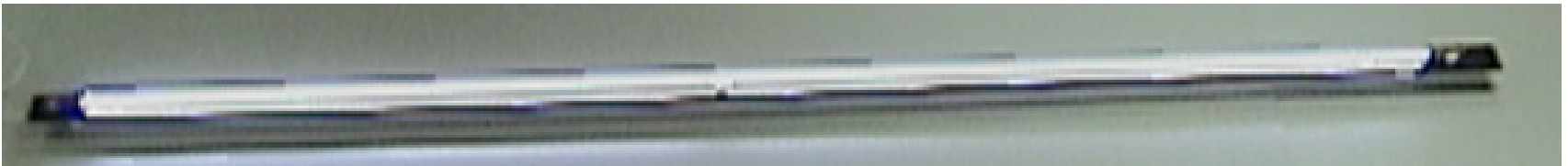
393 mm

355 mm

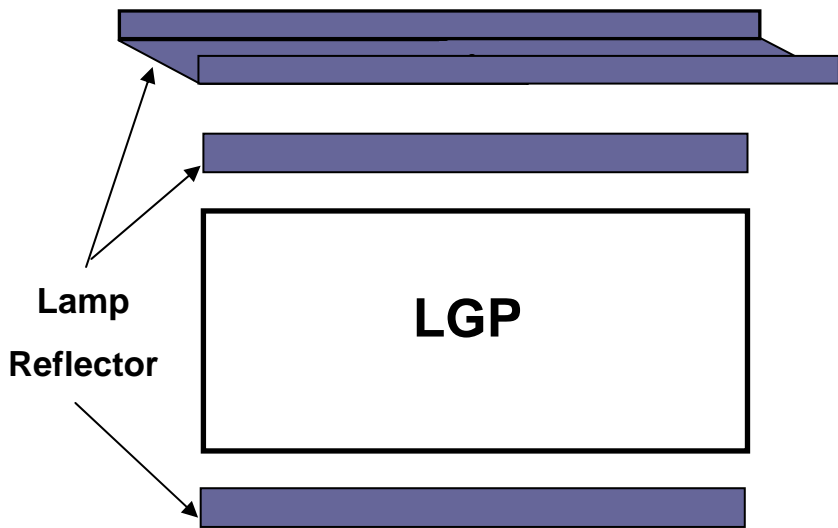
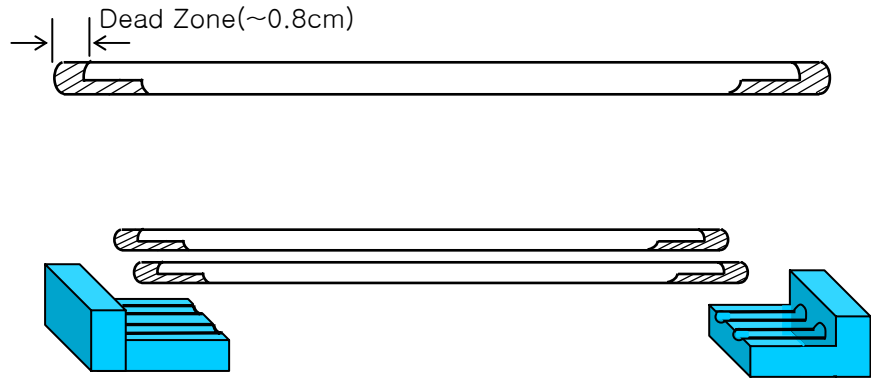
314 mm

291 mm

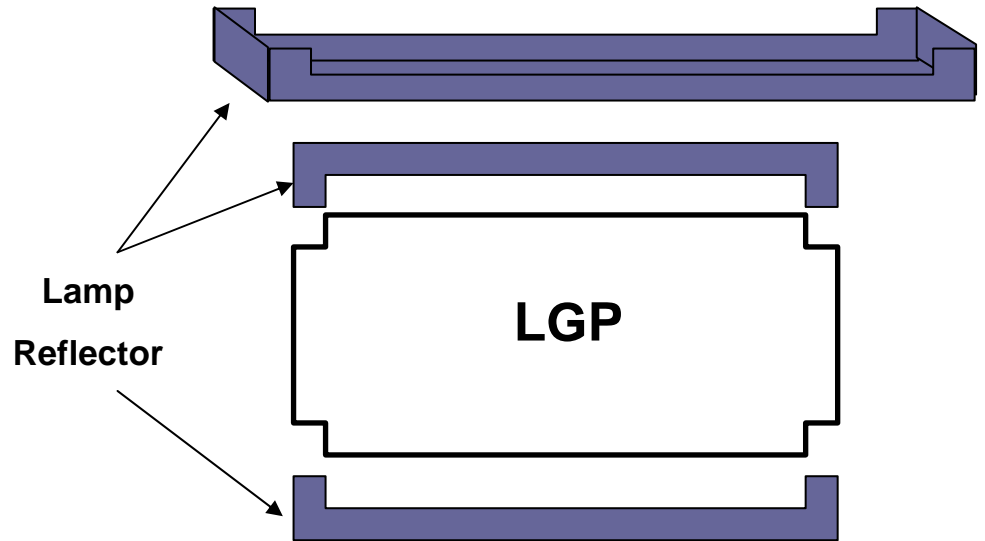
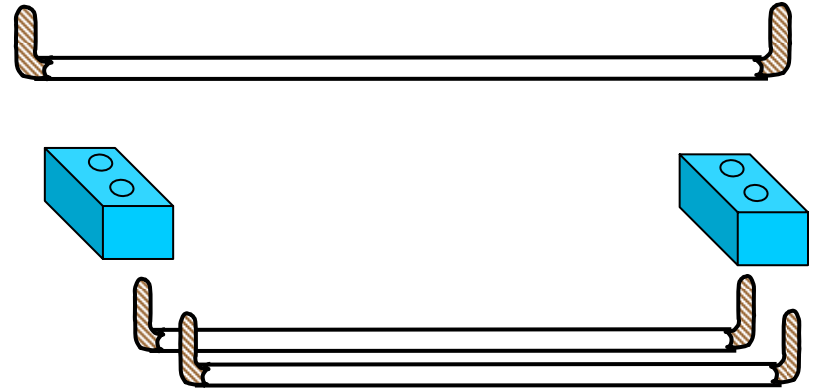
1000 mm



## 1) Elongated Bottom Electrode

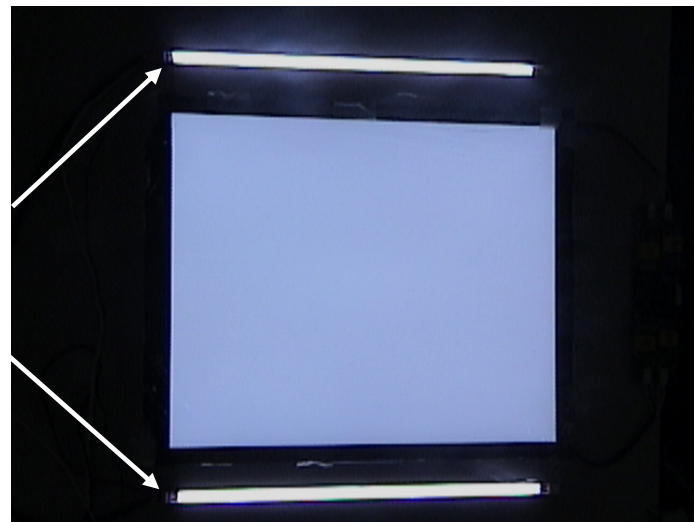
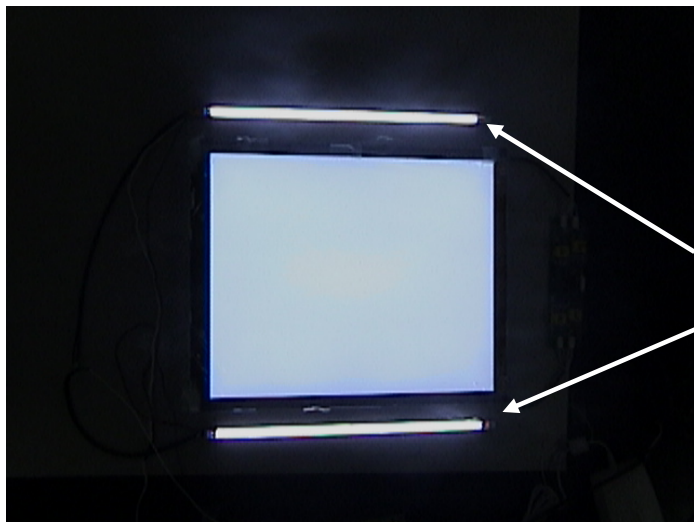


## 2) Bended Electrode



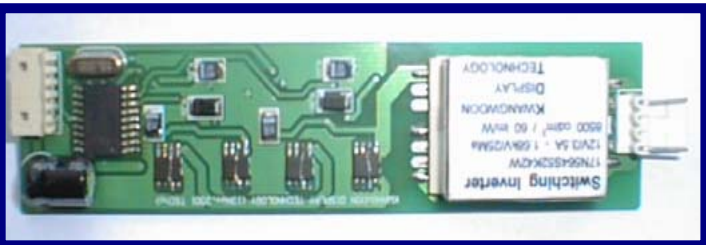
17" Panel

19" Panel



Reflector

Full-Bridge Switching Inverter



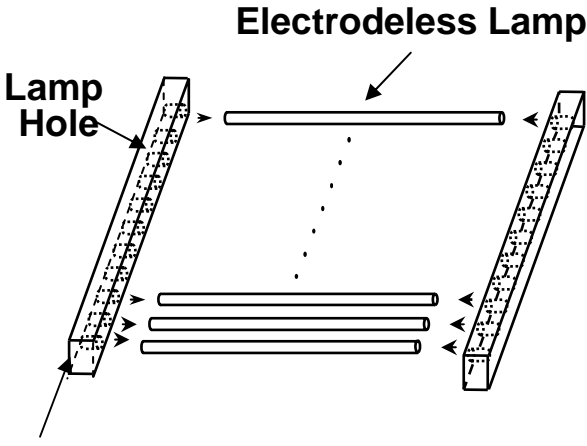
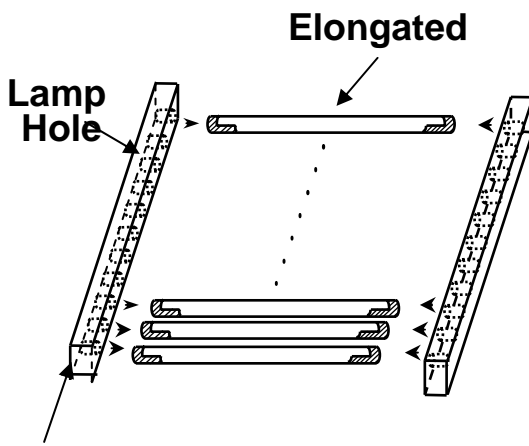
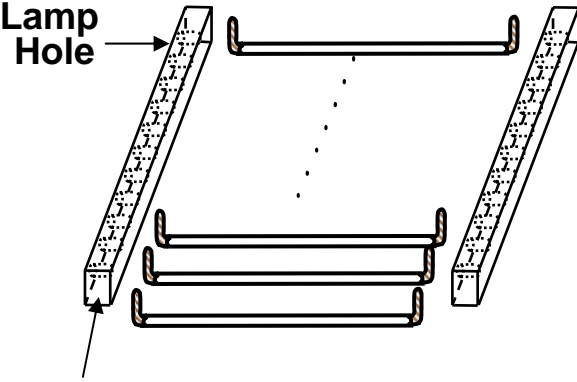
( 12 \* 3 \* 1 ) (cm)

Multi-Vibrator Switching Inverter



( 15 \* 3 \* 1 ) (cm)

# EEFL-Direct Lighting Backlight

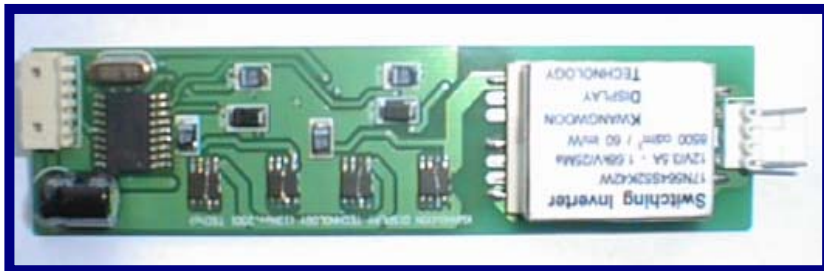
| Type1 : Electrodeless Lamps   | Type2 : Elongated EEFLs  | Type3: Bended EEFLs   |
|---|--|---|
|  <p>Electrodeless Lamp</p> <p>Lamp Hole</p> <p>Lamp Connector<br/>(Conductive Lubber Inside Hole)</p> |  <p>Elongated</p> <p>Lamp Hole</p> <p>Lamp Connector<br/>(Copper Inside Hole)</p> |  <p>Lamp Hole</p> <p>Lamp Connector<br/>(Copper Inside hole)</p> |
| <ul style="list-style-type: none"> <li>- Simple Connection</li> <li>- Low Efficiency ~50 lm/W</li> </ul>   | <ul style="list-style-type: none"> <li>- Narrow Dead Zone</li> <li>- High Efficiency ~ 60 lm/W</li> </ul>   | <ul style="list-style-type: none"> <li>- Narrow Dead Zone</li> <li>- High Efficiency ~ 60 lm/W</li> </ul>   |

# EEFL-Backlight ( Direct-Lighting )

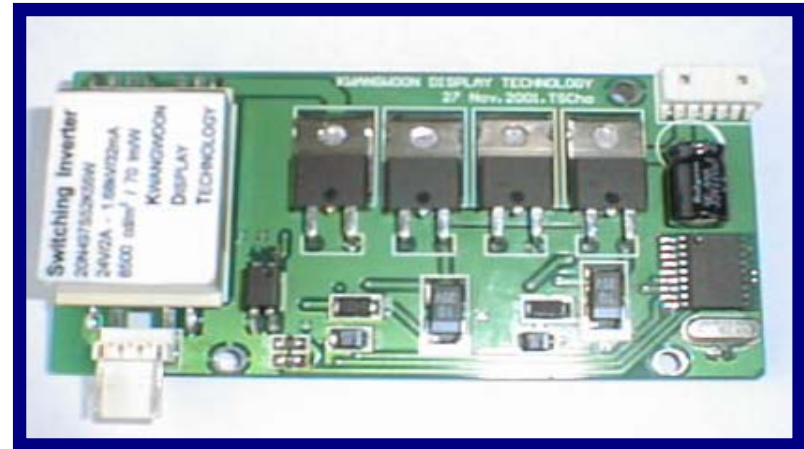
20.1" Panel



Diffusion Plate Opened



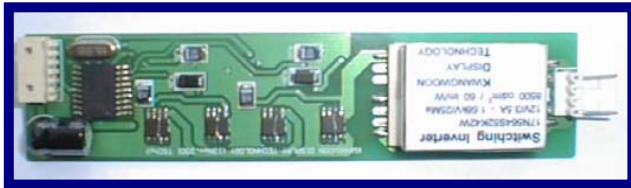
( 12 \* 3 \* 1 ) (cm)



( 9.5 \* 4.8 \* 1 ) (cm)

# EEFL-Backlight ( Direct-Lighting )

## Full bridge Switching Inverter



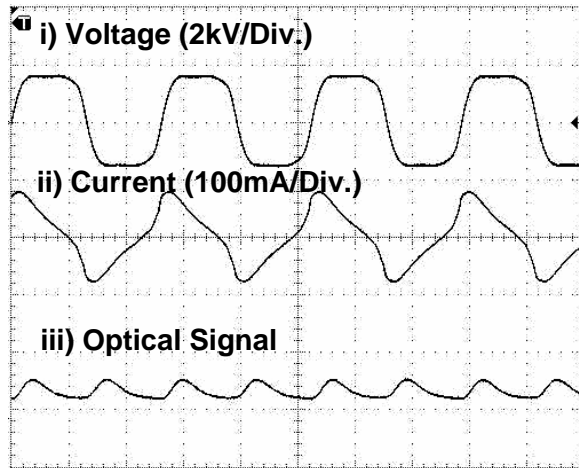
( 12 \* 3 \* 1 ) (cm)

## Multi-Vibrator Switching Inverter

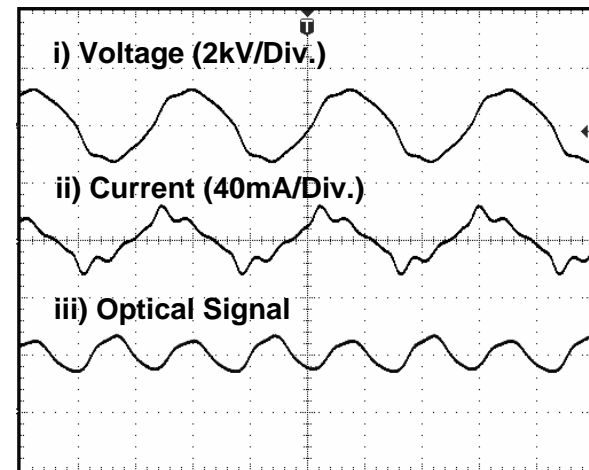


( 15 \* 3 \* 1 ) (cm)

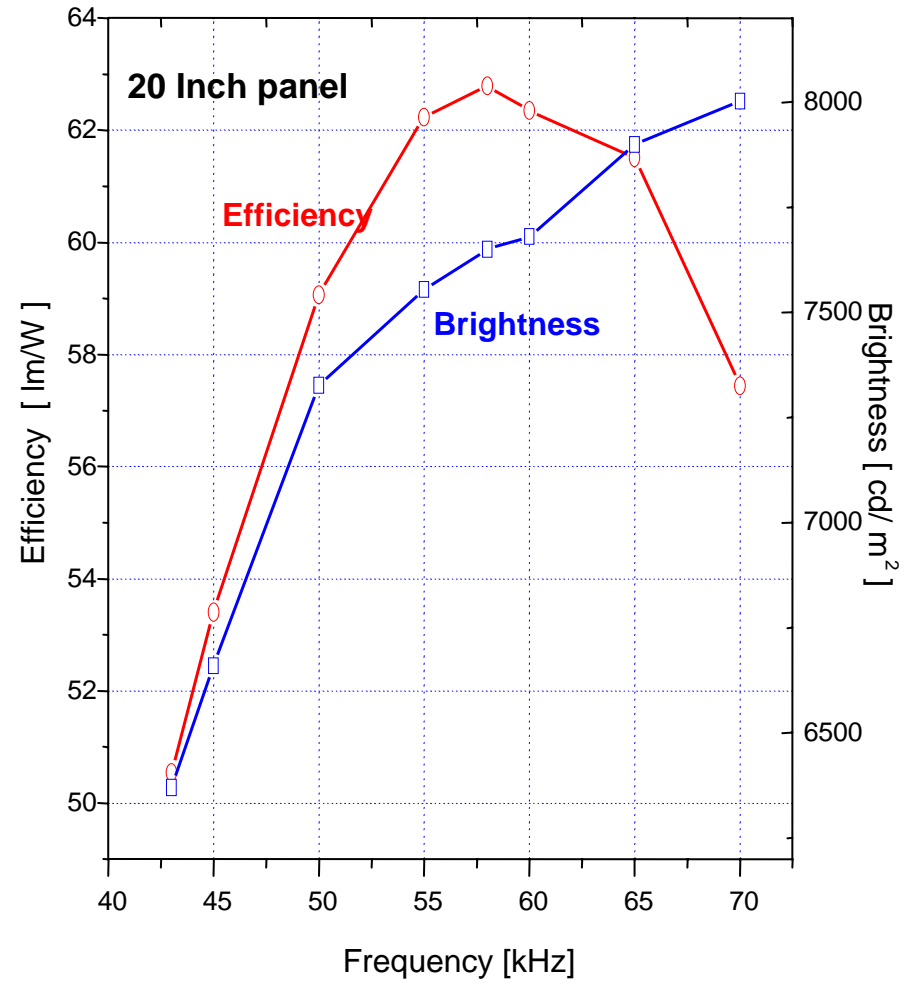
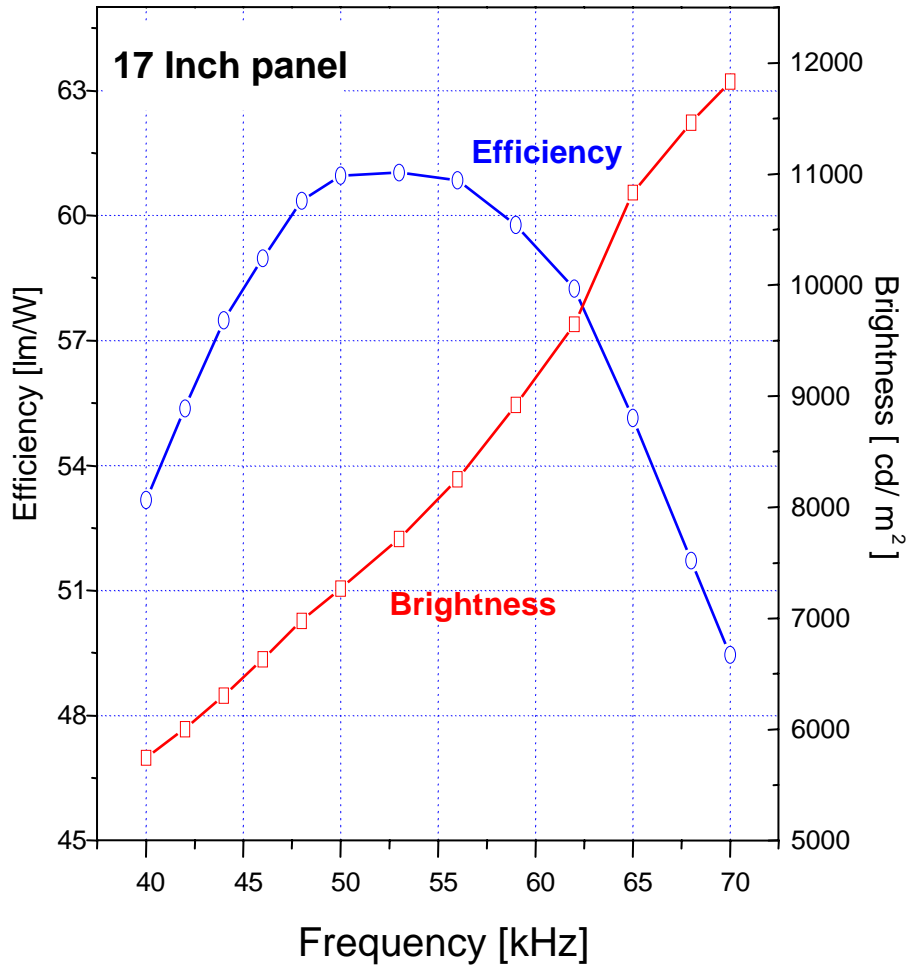
12 - EEFLs



12 - EEFLs

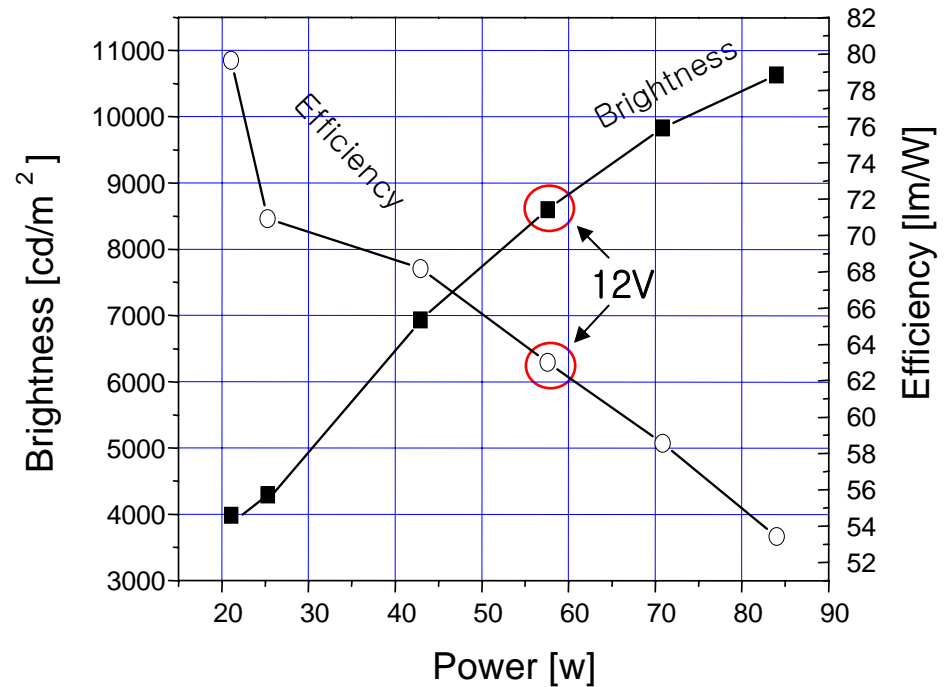
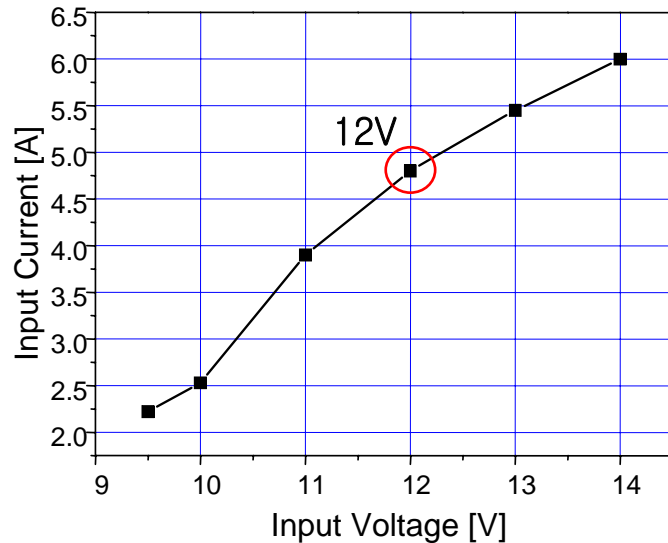
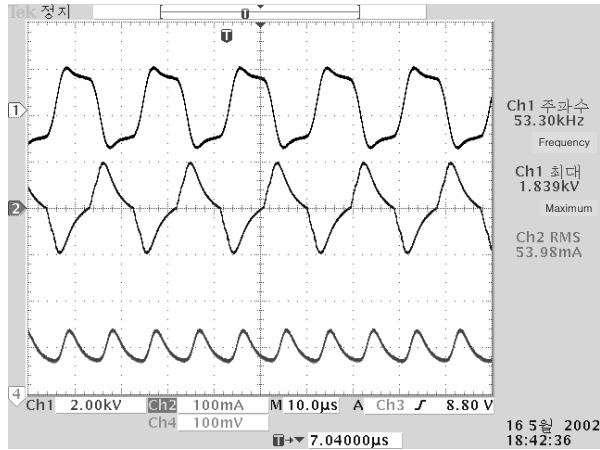


## Cu-Taping Electrode



# EEFL-Backlight ( Direct –Lighting )

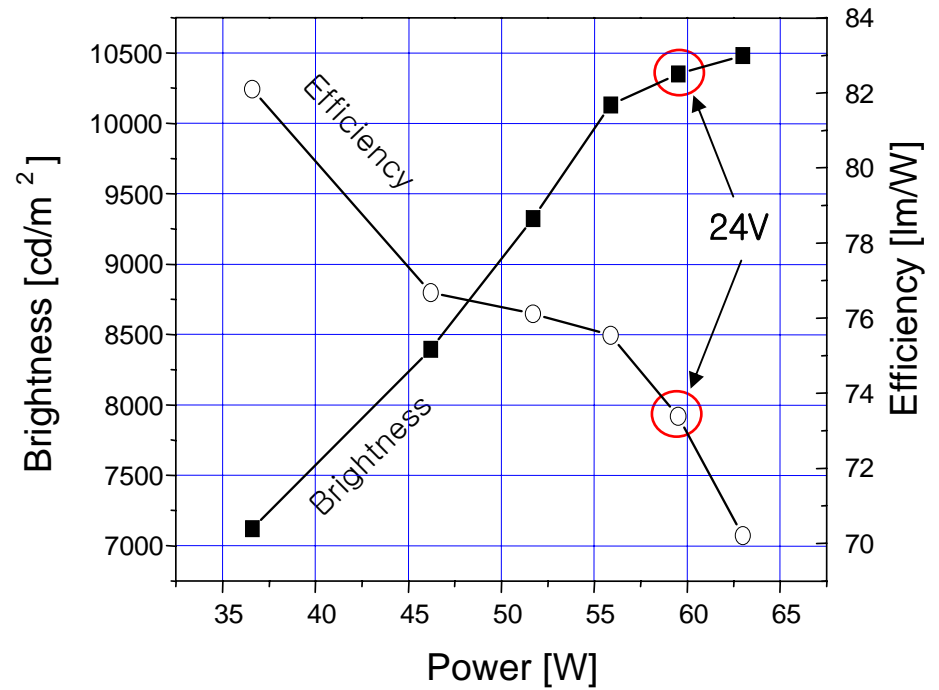
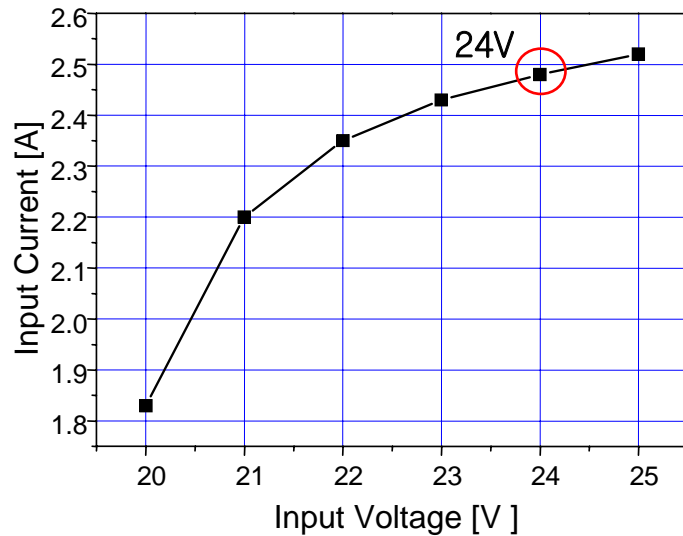
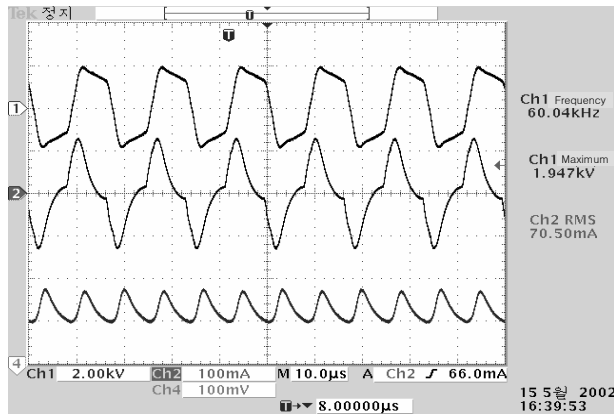
## 20.1 Inch (Input : 12V) : Metal-Bonding Electrode





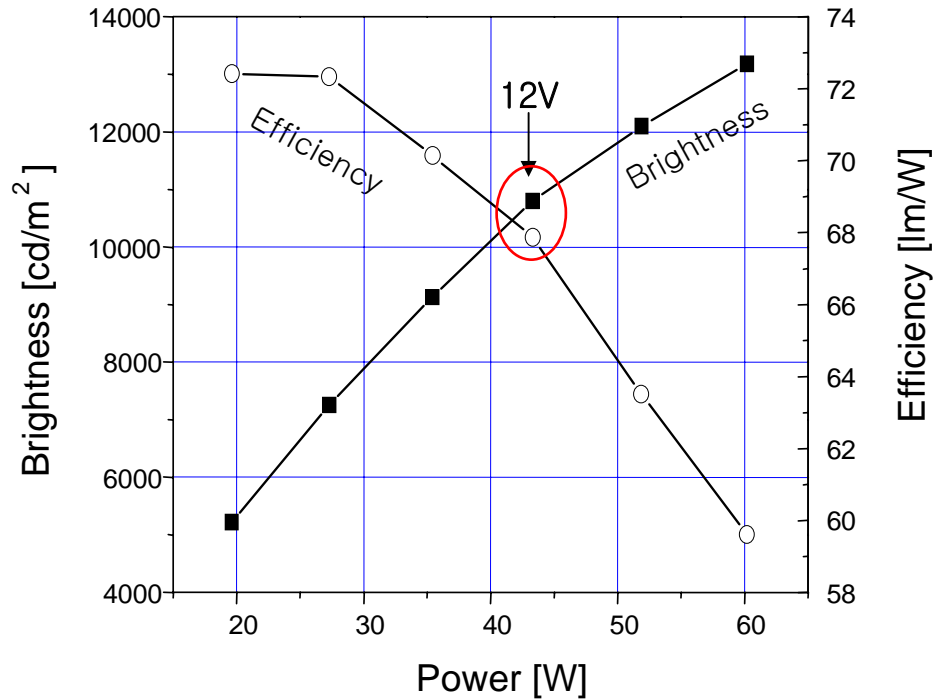
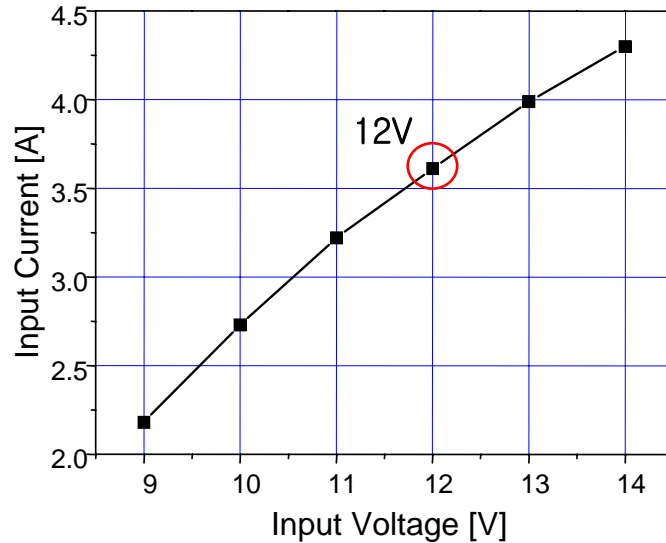
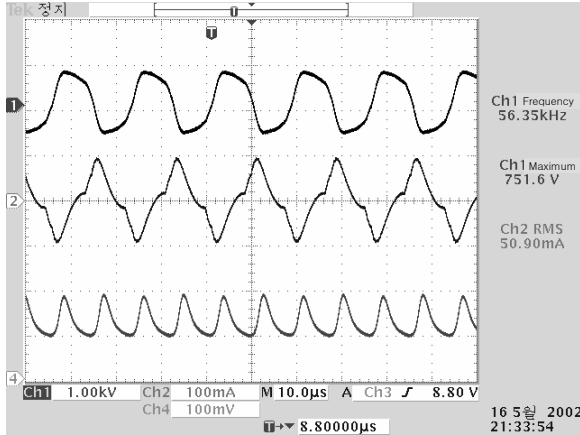
# EEFL-Backlight ( Direct –Lighting )

## 20.1 Inch (Input : 24 V) : Metal-Bonding Electrode



# EEFL-Backlight ( Direct –Lighting )

## 17 Inch (Input :12V) : Metal-Bonding Electrode



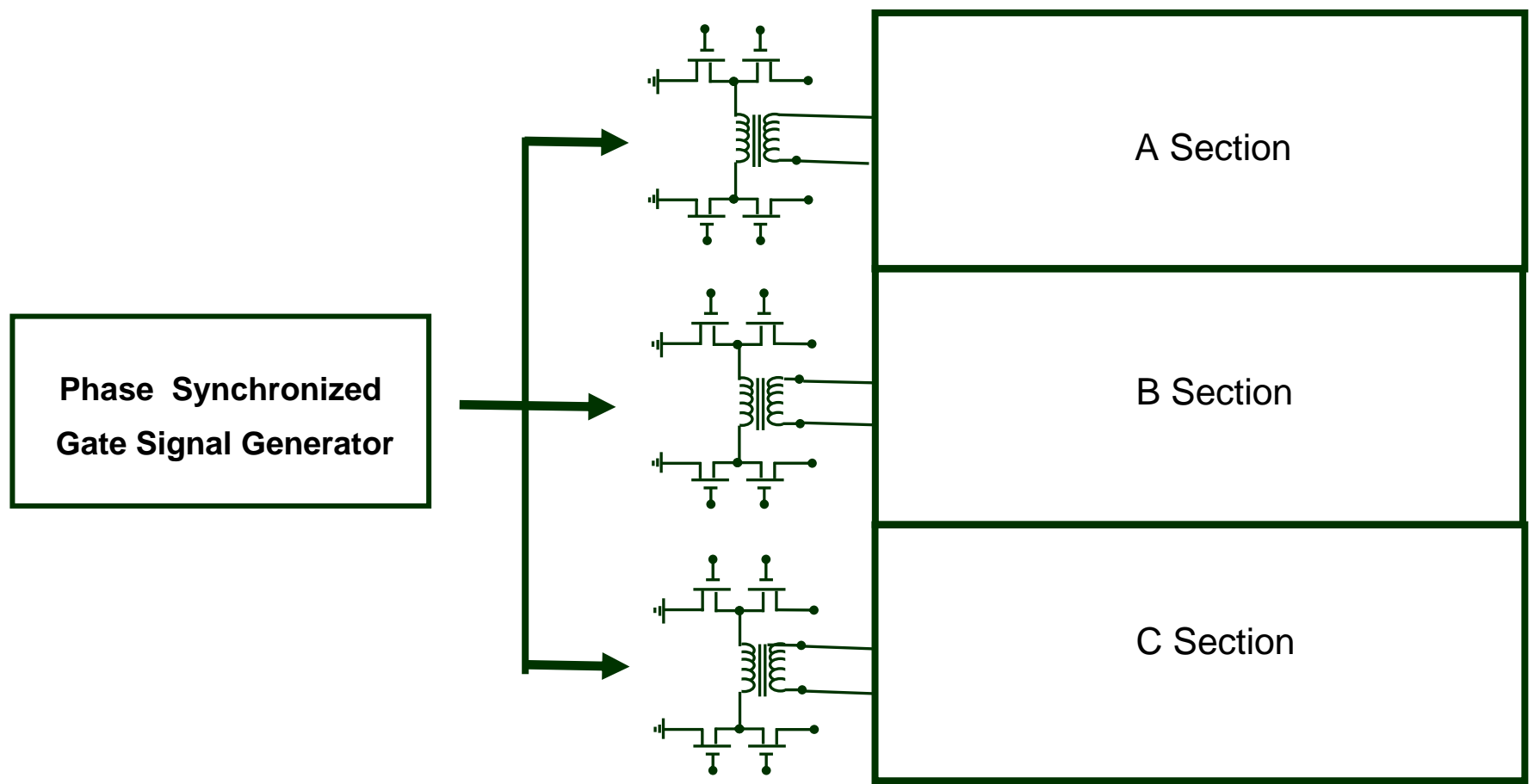
# EEFL-Backlight specification

## - Metal Bonding External Electrode

|                  | Conventional<br>Edge-Lighting | Direct Lighting             |                              |                          |
|------------------|-------------------------------|-----------------------------|------------------------------|--------------------------|
| panel            | 17 inch<br>38.4*28*2(cm)      | 17 inch<br>38.4*28*2(cm)    | 20.1 inch<br>44.5*31*2(cm)   |                          |
| Tubes            | 4- lamps                      | 12 - lamps                  | 14 - lamps                   |                          |
| Inverter<br>size | LC-Resonance<br>16*4.5*1 (cm) | Full Bridge<br>12*2.8*1(cm) | Full Bridge<br>9.5*4.8*1(cm) |                          |
| Input            | 12V/ 1.7A                     | 12V/ 3.61A                  | 12V/ 4.68A                   | 24V/ 2.48A               |
| Input<br>Power   | 20 W                          | 43 W                        | 56 W                         | 59 W                     |
| Frequency        | 50 KHz                        | 56 KHz                      | 53 KHz                       | 59 KHz                   |
| Brightness       | 3,500 cd/m <sup>2</sup>       | 11,000 cd/m <sup>2</sup>    | 8,650 cd/m <sup>2</sup>      | 10,300 cd/m <sup>2</sup> |
| Efficiency       | 50 lm/W                       | 70 lm/W                     | 64 lm/W                      | 73 lm/W                  |

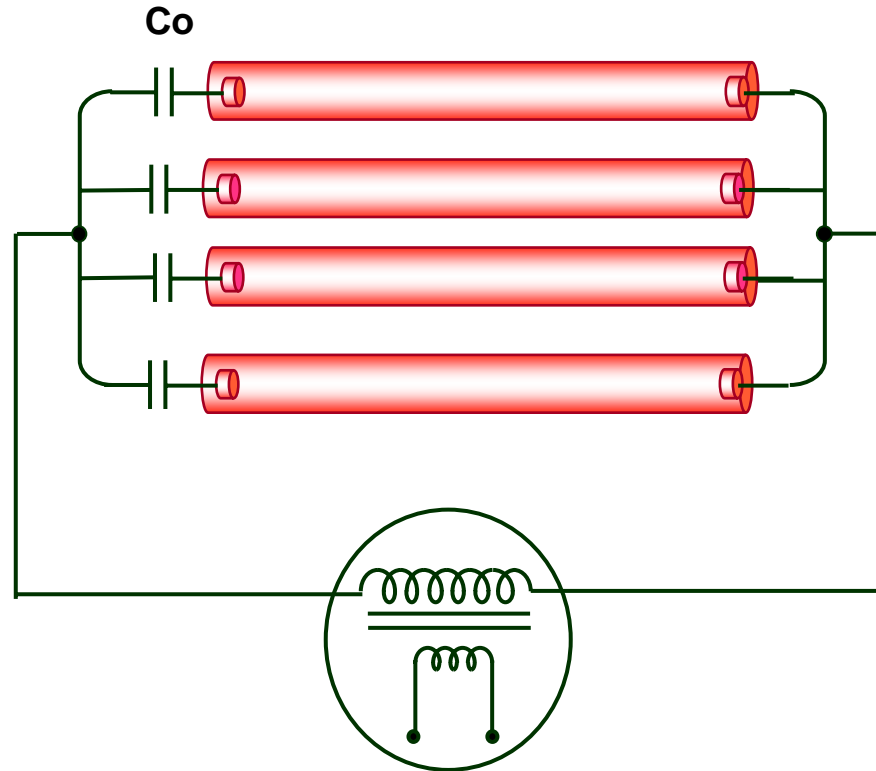
# A large Area Backlight about 40 inch in diagonal

Confidential



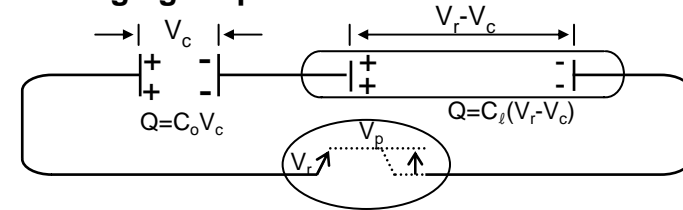
# Multi-CCFLs Driven by a Switching Inverter

- Self Discharge Synchronizing provides a high Efficiency

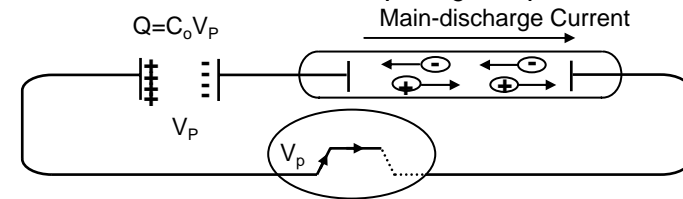


•  $C_o$  : Synchronizing Capacitor for the Uniformity

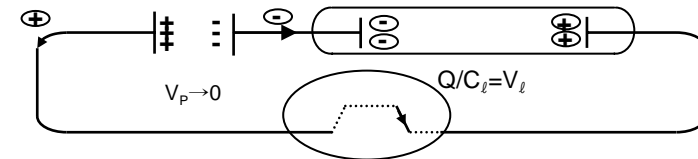
a) Rising Voltage : Charging Capacitor



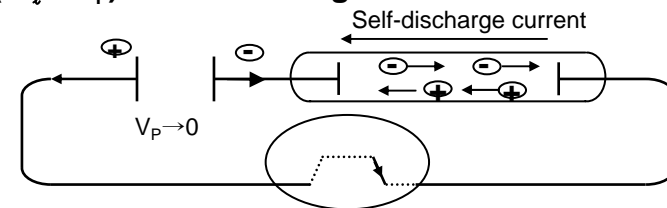
b) Rising & Sustaining : Main discharge ( $V_r - V_c > V_f$ )



c) Falling Voltage : Charging Lamp



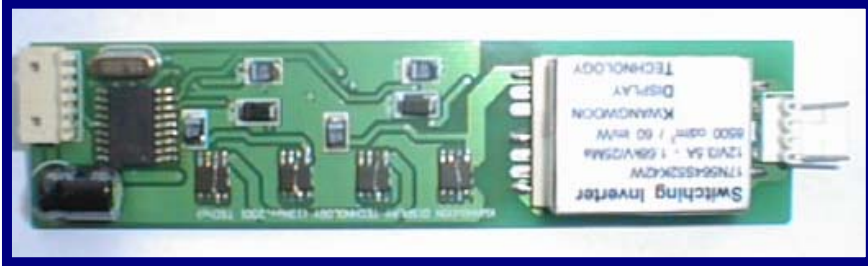
d) Falling Voltage ( $V_l > V_f$ ) : Self-discharge





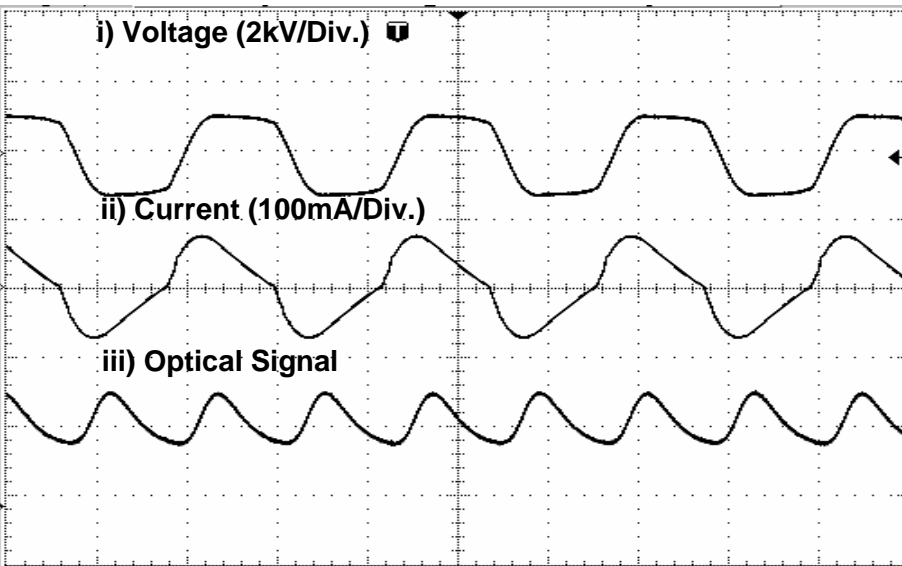
# CCFL Backlight ( Direct-Lighting )

## 1) Full bridge Switching Inverter

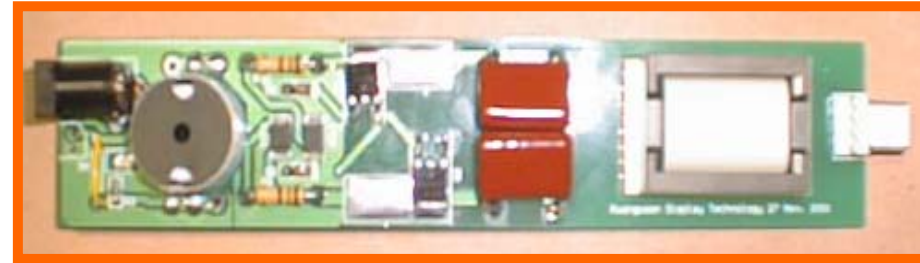


( 12 \* 3 \* 1 ) (cm)

- 12 – CCFLs : 17 inch Panel

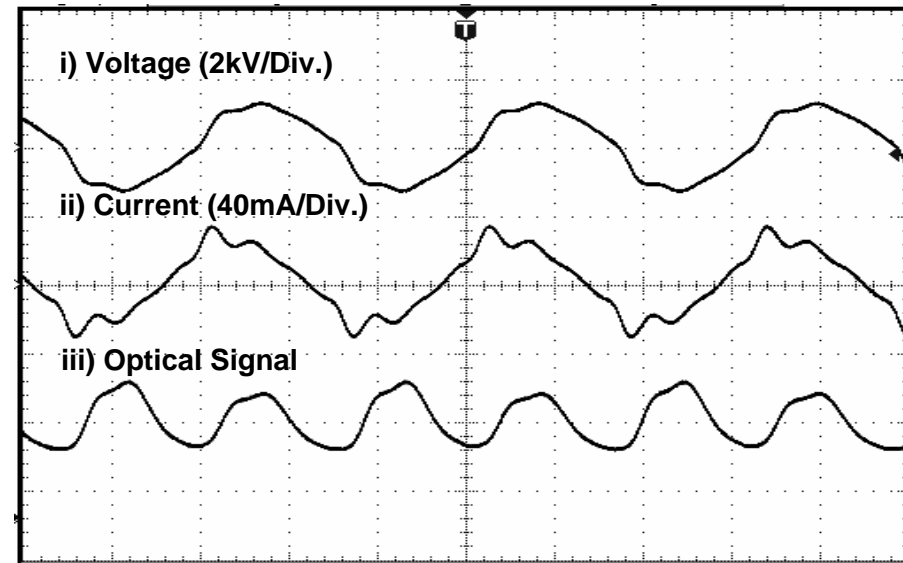


## 2) Multi-Vibrator Switching Inverter



( 15 \* 3 \* 1 ) (cm)

- 12 – CCFLs : 17inch Panel



## **1. High Brightness & High Efficiency EEFLs ;**

- External Electrode Formulated by Metal-Glass Melt-Bonding
- A Self-Discharge Synchronizing Operation
- By a Switching Inverter

## **2. Edge-Lighting EEFLs-Backlight Panels ;**

- A good Uniformity obtained with single Transformer on a single Stage Inverter.

## **3. Direct-Light EEFLs-Backlight Panels of 17 & 20.1 inch in Diagonal**

- High Luminance of 7,000 ~ 10,000 cd/m<sup>2</sup>
- High Efficiency of 70 ~ 80 lm/w  
(With single Transformer on a single Stage Inverter.)



# **EEFL-Backlight & Switching Inverter promise a new generation of LCD Backlight & Operation**

- **Low Power consumption**
- **Long Life Time**
- **High Brightness Backlight Up to ~ 10,000 cd/m<sup>2</sup>**
- **High Efficiency Up to ~ 70 lm/W**
- **Application to a Large Size Backlight Up to 1m×1m inch LCD**
- **Low Cost**
- **Simple Assembly**

**< Ref from Presentation at SID'02 Boston by KDT >**