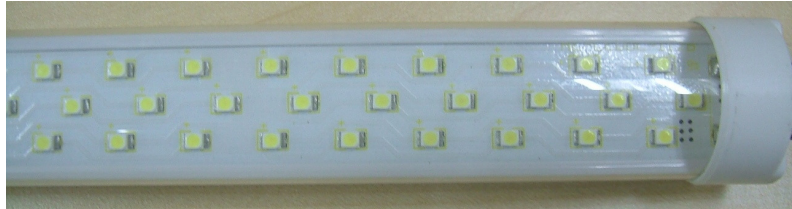


APPLICATION NOTES:

Using DomiPlus As LED Light Source For T8/T10 Tube Light.

Introduction:

LED T8/T10 Fluorescent replacement light tube has commonly available in the market since last two years.



There are various types of LED package use for this LED T8/T10 tube. The 2 most common type of LED package used are:

- (i) 3528 type LED with typical power of 60mW per LED and
- (ii) 5050/6060 type LED with typical power of 0.5W or 1W

Nevertheless, there are both pro and cons of using these 2 types of LED in T8/T10 application:

3528 Package

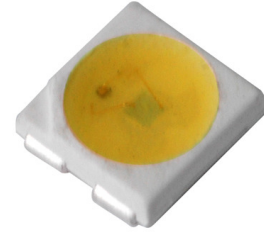
	Pro		Cons
1	High optical efficiency	1	Usually 250/300 pieces of LED is required, substantial SMT cost and LED packaging cost
2	Wide spread of LED distribution across the pcb to enhance heat dissipation	2	Complicated pcb track design, imbalance current flowthrough each parallel string of LED might cause thermal runaway
3	Since quantity of LED use is huge, there is less bright spot observed on the tube	3	Left little space on the pcb board to mount other electronic component.

5050/6060 Package

	Pro		Cons
1	Use up to 36 piece of LED only, save packaging and SMT cost	1	Obvious bright spot on LED tube due to high intensity point light source
2	Simple pcb and LED driving circuit design	2	Shadowing effect due to LED is widely space from one to another
3	Ample space on the pcb to slot in other electronic component	3	Challenging heat management due to localize point heat source

In order to gain advantage of 3528 package while filling in the short fall, Dominant has introduced DomiPlus LED package with the following features for light tube application:

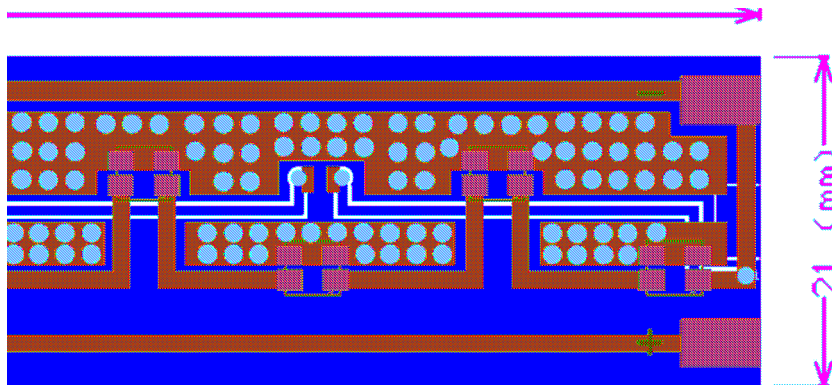
- ⇒ Typical drive current of 60mA (200mW).
- ⇒ Electrically isolated terminal for simple heat sinking.
- ⇒ High optical efficiency.
- ⇒ Large light emitting surface.



Optical Design Consideration For T8/T10 Light Tube

Typically for the LED T8/T10 light tube, 308 pieces of 3528 LED is used in the design with total flux output of about 1600 lumen. Based on this calculation, the same total flux output can be achieved by using only 104 pieces DomiPlus LED, which is 66% reduction in LED count.

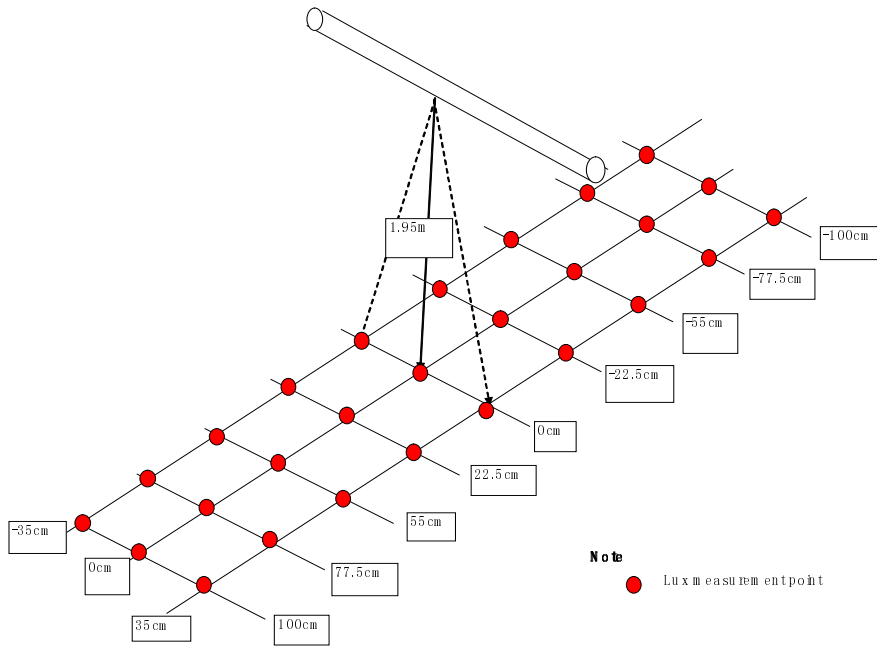
The T8 light bar can be designed by using DomiPlus with a LED to LED pitch of 11.2mm in a 1.2m length T8 light bar application. The LEDs are arranged in a 2 rows formation to ensure more uniform light output from both sides of the light tube. A probable lay-out is as per illustrated below.



This application note will demonstrate the performance of DomiPlus versus current typical designs. The DomiPlus design was compared with the following:

- (i) A standard 36W fluorescent lamp
- (ii) A LED T8 light tube with 308 pieces 3528 LED (frosted cover)
- (iii) Newly develop T8 light tube with 104 pieces DomiPlus LED (frosted cover)

Light Tube Measurement Setup



1. Reference: Measurement Of Standard 36W Fluorescent Lamp

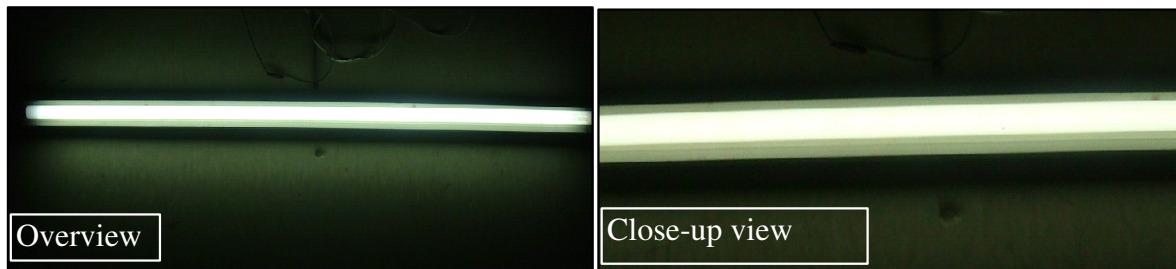
Height: 1.95m

Lux Meter : Center 337 Mini Lightmeter

Date 1/4/2010

Point	-100cm	-77.5cm	-55cm	-22.5cm	0	22.5cm	55cm	77.5cm	100cm
-35cm	60	65	67	67	63	67	67	65	60
0	61	69	72	73	68	73	72	69	61
+35cm	59	68	71	72	68	72	71	68	59

Photo



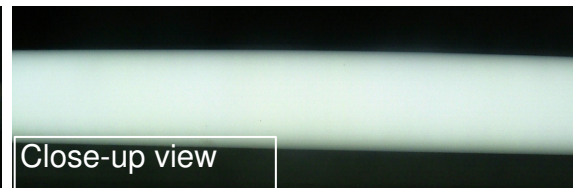
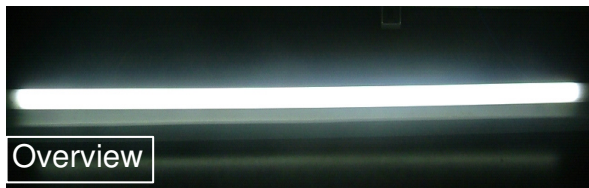
2. Measurement Results Of Light Tube With 308 Pieces 3528 LED (Frosted Tube)

Height: 1.95m

Lux Meter : Exttech Easy View 31 (LUX)

Date 1/21/2010

Point	-100cm	-77.5cm	-55cm	-22.5cm	0	22.5cm	55cm	77.5cm	100cm
-35cm	82	87	97	103	103	104	98	87	82
0	84	92	102	109	109	109	102	92	84
+35cm	82	89	97	106	103	106	99	89	82



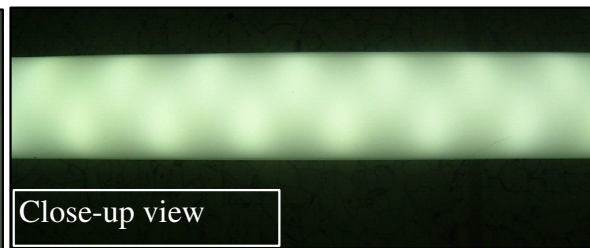
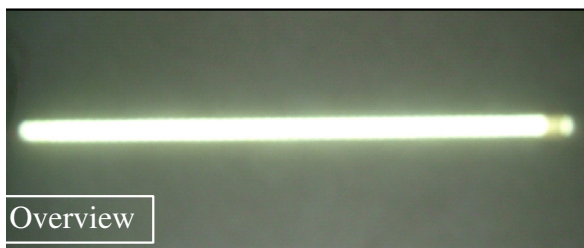
3. Measurement Results Of Light Tube With 104 Pieces DomiPlus LED (Frosted Tube)

Height: 1.95m

Lux Meter : Center 337 Mini Lightmeter

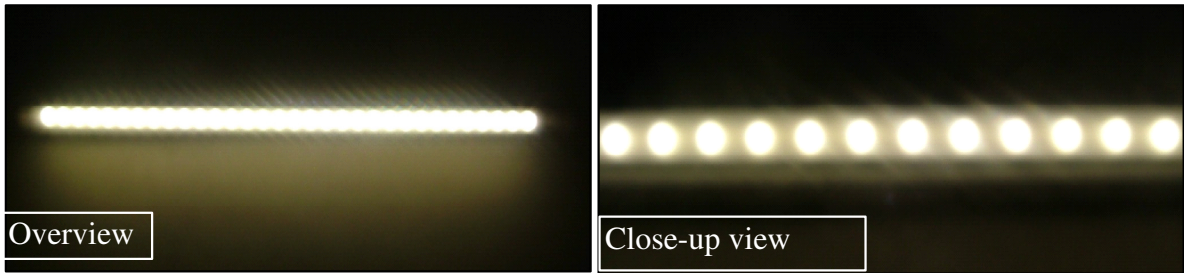
Date 5/4/2010

Point	-100cm	-77.5cm	-55cm	-22.5cm	0	22.5cm	55cm	77.5cm	100cm
-35cm	76	80	88	97	102	97	88	81	76
0	78	83	95	102	106	102	95	83	77
+35cm	76	82	93	101	102	101	93	82	74



Comment:

- ⇒ The flux measurement above shows that the surface luminance of light tube build with 104 pieces of DomiPlus is comparable to light tube with 308 pieces of 3528 LED.
- ⇒ The surface of frosted tube will show an alternate bright/dim pattern when using the 104 pieces of DomiPlus LED. This is only obvious upon close up. However, the bright spot is certainly less visible compares to 5050/6060 type high power LED as displayed below:



CRI Enhancement

The CRI for light tube can also be enhanced by addition of amber light element. In this case, SpiceLED LED, SSA-NLD is used to introduce the amber light for color mixing. With this combination, the light output can achieve CRI of 80 and above.

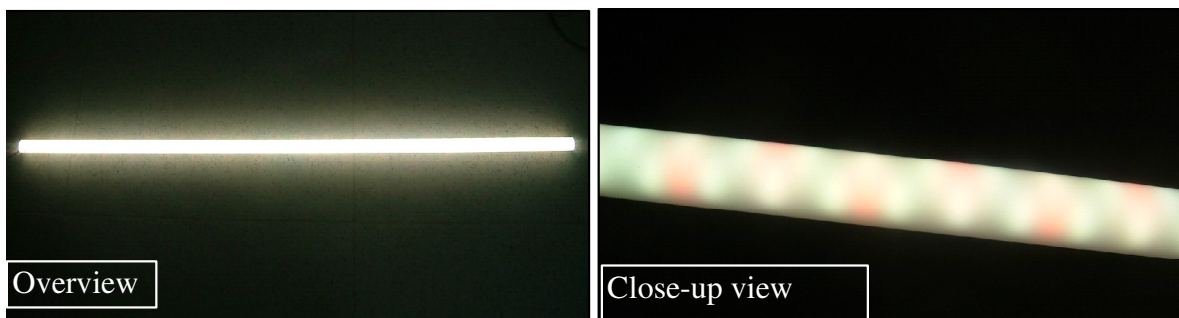
4. Measurement Results Of Light Tube With 104 Pieces DomiPlus LED And 34 SpiceLED (Note: measured with fix power as cool white model)

Height: 1.95m

Lux Meter : Center 337 Mini Lightmeter

Date 5/4/2010

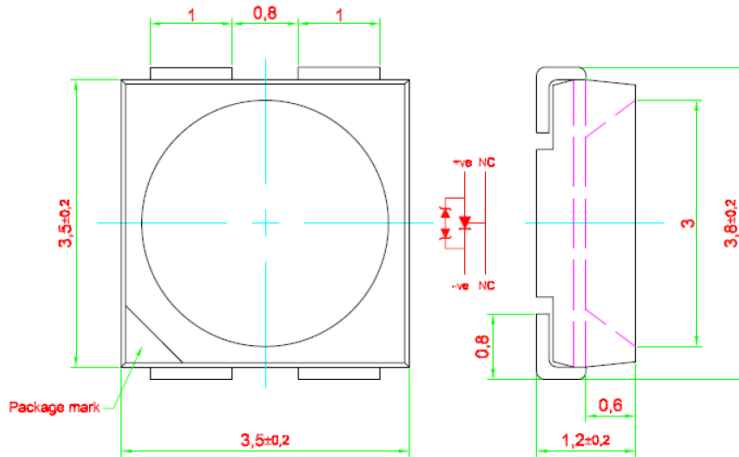
Point	-100cm	-77.5cm	-55cm	-22.5cm	0	22.5cm	55cm	77.5cm	100cm
-35cm	65	74	85	95	97	95	85	74	65
0	70	79	91	102	104	102	91	79	70
+35cm	67	87	89	101	101	101	89	87	67



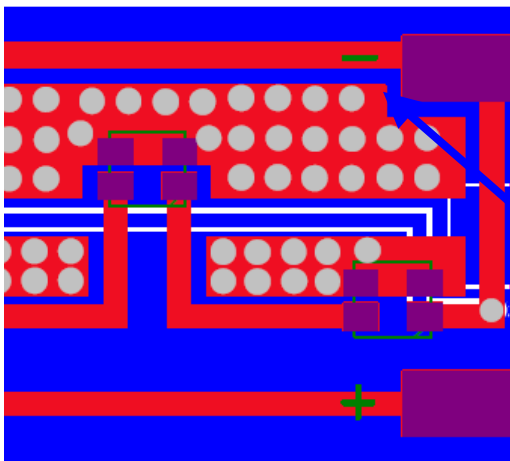
Thermal Design Consideration

DomiPlus is designed with 2 NC pads for direct heat sink attachment. It is constructed in such a manner that the electrical current paths are separated from the thermal path. This allows design of standard dual side FR4 PCB with plated through copper via to achieve maximum thermal conductivity directly from the NC pad down to the rear side of the PCB.

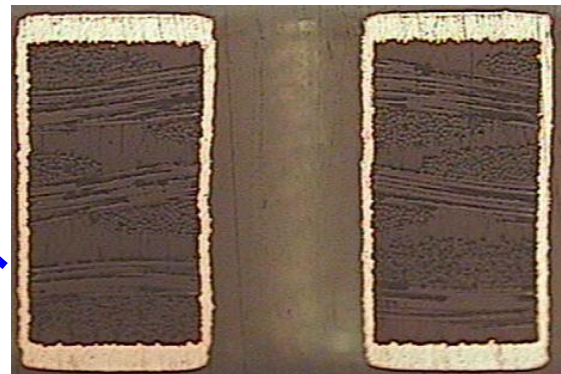
The rear side of the PCB is typically covered with copper and the PCB is mounted onto the metal casing of the lighting unit. This significantly improves the thermal management and in turns the reliability of the LEDs.



DomiPlus solder lead design



PCB Cross Section



Through Hole Copper Plated Via On PCB

With standard 60mA per LED driving condition, the LED solder point temperature can be maintained at 45 deg C in an enclosed tube.



With this enhanced LED thermal management, the LED light intensity can be maintained at >90% level during light up.

Summary

DomiPlus LED is a highly cost effective solution for T8/T10 light tube application that possesses the strength of both 3528 and 5050/6060 package. Even though the color tone on the frosted casing might appear slightly uneven, it manages to eliminate the glaring bright spot as seen using 5050/6060 package while maintaining the illuminated surface brightness.