



Product Training Module: Li98 Thermally Conductive Adhesive Tape for LED Lighting Applications

April 2013



Introduction

- Purpose
 - This training module is used to give an introduction to t-Global Technology's range of thermally conductive adhesive tape designed for LED lighting applications
- Objectives
 - To identify the key properties of the Li98 product range
 - To identify the key design criteria for the Li98 product selection
- Content
 - Introduction and background to the product range
- Learning time
 - 30 mins

Introduction

- LED lighting is becoming increasingly common in all sectors
- Key benefits of LED over conventional lighting include:
 - Increased efficiency
 - Increased life time
 - Increased aesthetic appeal
 - Increased lighting stability
 - Reduced overall cost of ownership





Thermal Management in LEDs

- LEDs are solid state devices which convert electricity to light and heat
- The wall-plug efficiency (optical power out divided by electrical power in) of LED packages is typically in the region of 5-40%.
- As the junction temperature of an LED is increased:
 - both the forward voltage and the lumen output decrease
 - The output wavelength also shifts with a change in junction temperature.

Thermal Management Issues

- LEDs have unique thermal management problems
- Thermal management is critical for:
 - Life time
 - Reliability
 - Color stability
- Thermal management in LED systems relies mainly on conduction of heat away from the die
- This presents new challenges to designers used to working with conventional lighting





Thermal Management in LEDs

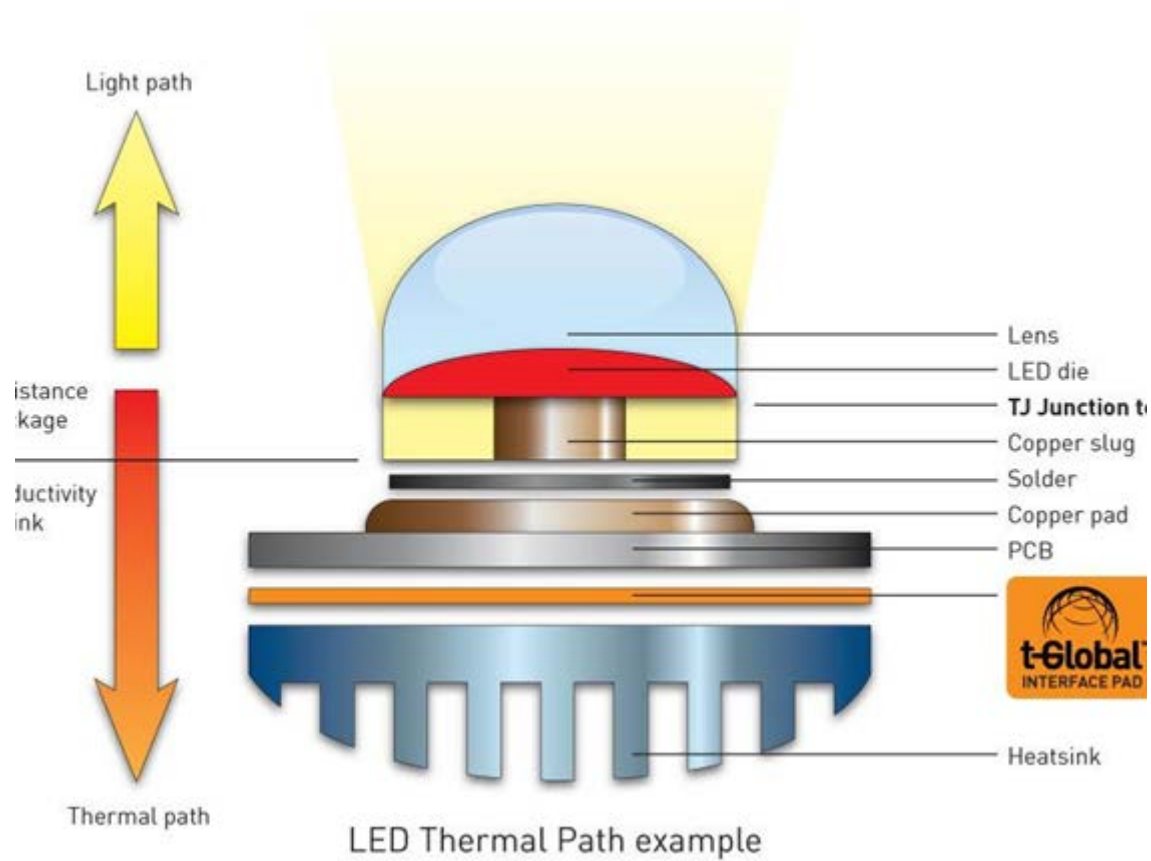
- Failure to remove this heat results in reduced life times and lower efficiency
- Most significantly, the junction temperature affects the lifetime of the LED
- Heat should be conducted away from the backside of the LED in an efficient manner, and then removed from the area by convection.
- This latter process can be passive, involving convection from the outside of the package or from a finned heatsink with a large surface area



Thermal Management in LEDs

- The main ways of passively managing the thermal demands for LEDs are:
 - Thermally Conductive Adhesives / Tapes
 - Heat sinks plus a TIM material
- To obtain efficient thermal management it may be necessary to use all of the above techniques in combination

Thermal Path for LEDs



Thermally Conductive Adhesives Tapes



- Thermally conductive adhesives and thermally conductive adhesive tapes can be used to passively manage the junction temperature of LEDs
- Thermally conductive adhesive tapes, such as t-Global's Li98, provide an excellent path for thermal transfer as well as a reduction in engineering complexity due to the removal of screws, clips and other fixtures



LI - Series

- The LI series is t-Global Technology's core thermally conductive adhesive tape product line
- Each member in the family has been developed to address specific industrial needs where attachment and thermal conductivity are key design requirements
- All products in this series are available as standard sheets, custom-die cuts and on rolls



LI-98

- LI-98 has a thermal conductivity of 0.95 W/m.k
- LI-98 is available in thickness of 0.15 and 0.25mm
- LI-98 has a lap shear strength of 61 N/cm²
- Common applications include:
 - Mounting heatsinks to components dissipating \leftarrow 30W
 - Attachment of heatsinks to PCs
 - Attachment of motor control units
 - Telecom infrastructure components
 - LED lighting applications

LI-98C

- LI-98C has a significantly higher thermal conductivity than LI-98 for more demanding applications
- The thermal conductivity is 1.8 W/m-k
- The lap shear strength is 65 N/cm² which equates to good adhesion
- The material also has a high dielectric breakdown voltage
- The materials is commonly used in:
 - LED assemblies
 - Motor control units
 - Power amplifier units

LI-98 and LI-98C Datasheet

Property	Li-98		Li-98C	Unit	Test Method
Colour	White	White	White	-	Visual
Thickness	0.15	0.25	0.2	-	ASTM D374
Reinforcement Carrier	Fiberglass mesh			-	-
Density	1.85	1.85	1.9	g/cm ³	ASTM D792
Tensile Strength	200	400	200	psi	ASTM D412
Glass Transition Temperature	-30	-30	-27	°C	-
Short Time Use Temperature (30 sec)	200	200	200	°C	-
Continuous Working Temperature	-30 to 120	-30 to 120	-30 to 120	°C	-
Thermal Conductivity	0.95	0.95	1.8	W/m.k	ASTM D5470
Thermal Impedance @ <1psi	1.0	1.8	0.7	°C in ² /W	ASTM D5470
Thermal Impedance @ 50psi	0.9	1.5	0.5	°C in ² /W	ASTM D5470
Initial Tack	11	10	14	cm	PSTC-6
Lap Shear Strength	61	61	65	N/cm ²	ASTM D1002
Die Shear Strength @ 25°C	120	120	118	N/cm ²	-
Die Shear Strength @ 80°C	69	69	68	N/cm ²	-
Holding Power 1000g @ 25°C using 1 in 2	>10000	>10000	>10000	min	PSTC-7
Holding Power 1000g @ 80°C using 1 in 2	>10000	>10000	>10000	min	PSTC-7
180° Peeling Strength (aluminum)	4	5	4	N/cm	ASTM D3330
Dielectric Breakdown Voltage (Vac)	>2	>3	>3	kV	ASTM D149
Dielectric Breakdown Voltage (Vdc)	>3	>4	>4	kV	ASTM D149

• REACH Compliant • RoHS Compliant



LI-2000

- LI-2000 is a thermally conductive adhesive tape
- LI-2000 is available in thickness of 0.15 and 0.25mm
- Based upon a silicone PSA and therefore provides excellent adhesion
- High thermal conductivity of 1.2 W/m-k
- High dielectric breakdown voltage
- Common applications for LI200 include:
 - LED systems
 - Wireless hubs
 - Gaming systems
 - Consumer devices



LI-2000 Datasheet

Property	LI-2000		Unit	Test Method
Colour	White	White	-	Visual
Thickness	0.15	0.25	mm	ASTM D374
Reinforcement Carrier	Fiberglass	Fiberglass	-	-
Continuous Working Temperature	-45 to 170	-45 to 170	°C	-
Short Time Use Temperature (30 sec)	288	288	°C	-
Initial Tack	10	10	cm	PSTC-6
Lap Shear Strength	74	78	N/cm ²	D1002
Die Shear Strength @ 25°C	113	126	N/cm ²	-
Die Shear Strength @ 80°C	80	85	N/cm ²	-
Die Shear Strength @ 150°C	30	35	N/cm ²	-
Holding Power 1000g @ 25°C using 1 in 2	>40000	>40000	min	PSTC-7
Holding Power 1000g @ 80°C using 1 in 2	>40000	>40000	min	PSTC-7
Holding Power 1000g @ 150°C using 1 in 2	>10000	>10000	min	PSTC-7
Tensile Strength	8	8	N/mm ²	ASTM D412
Dielectric Breakdown Voltage (Vac)	>2	>3	kV	ASTM D149
Dielectric Breakdown Voltage (Vdc)	>3	>4	kV	ASTM D149
Volume Resistance	10 ¹¹	10 ¹¹	Ohm-cm	ASTM D257
Thermal Conductivity	1.2	1.2	W/m.k	ASTM D5470
Thermal Impedance @<1psi	0.90	1.40	°C in ² /W	ASTM D5470
Thermal Impedance @<10psi	0.81	1.30	°C in ² /W	ASTM D5470
Thermal Impedance @<30psi	0.76	1.16	°C in ² /W	ASTM D5470
Thermal Impedance @<50psi	0.73	0.90	°C in ² /W	ASTM D5470
Thermal Impedance @<70psi	0.68	0.88	°C in ² /W	ASTM D5470
Thermal Impedance @<100psi	0.54	0.80	°C in ² /W	ASTM D5470
Flame Rating	V-1	V-1	-	UL94

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LI-2000A

- LI-2000A is a thermally conductive adhesive tape for high temperature applications
- LI-2000A is available in a thickness of 0.2mm
- It is based upon a silicone PSA and therefore provides excellent adhesion
- It has a high thermal conductivity of 2 W/m-k
- It has a high dielectric breakdown voltage
- Common applications for LI200A include:
 - Automotive systems
 - Gaming systems
 - Consumer devices

LI-2000A - Datasheet

Property	LI-2000A	Unit	Test Method
Colour	White	-	Visual
Thickness	0.2	mm	ASTM D374
Reinforcement Carrier	-	-	-
Continuous Working Temperature	-45 to 170	°C	-
Short Time Use Temperature (30 sec)	280	°C	-
Initial Tack	>30	cm	PSTC-6
Lap Shear Strength	35	N/cm ²	D1002
Die Shear Strength @ 25°C	60	N/cm ²	-
Die Shear Strength @ 80°C	50	N/cm ²	-
Die Shear Strength @ 150°C	40	N/cm ²	-
Holding Power 1000g @ 25°C using 1 in 2	>40000	min	PSTC-7
Holding Power 1000g @ 80°C using 1 in 2	>40000	min	PSTC-7
Holding Power 1000g @ 150°C using 1 in 2	>10000	min	PSTC-7
Dielectric Breakdown Voltage (Vac)	>3.5	kV	ASTM D149
Dielectric Breakdown Voltage (Vdc)	>4.5	kV	ASTM D149
Volume Resistance	10 ¹¹	Ohm-cm	ASTM D257
Thermal Conductivity	2.0	W/m.k	ASTM D5470
Thermal Impedance @<1psi	0.70	°C in ² /W	ASTM D5470
Thermal Impedance @<10psi	0.63	°C in ² /W	ASTM D5470
Thermal Impedance @<30psi	0.54	°C in ² /W	ASTM D5470
Thermal Impedance @<50psi	0.45	°C in ² /W	ASTM D5470
Thermal Impedance @<70psi	0.40	°C in ² /W	ASTM D5470
Thermal Impedance @<100psi	0.35	°C in ² /W	ASTM D5470
Flame Rating	V-1	-	UL94

• REACH Compliant • RoHS Compliant

Standard Die Cuts for LED Applications



- In order to fully support LED designers t-Global supplies a standard range of die cut parts specifically for the LED industry
- These parts allow the ultimate degree of flexibility for designers
- Additional benefits include:
 - Low cost of ownership
 - Low MOQ
 - Short leadtimes
 - Ease of assembly



LP Thermal Pad Series

t-Global Part Numbers for LED Die-Cut LP series

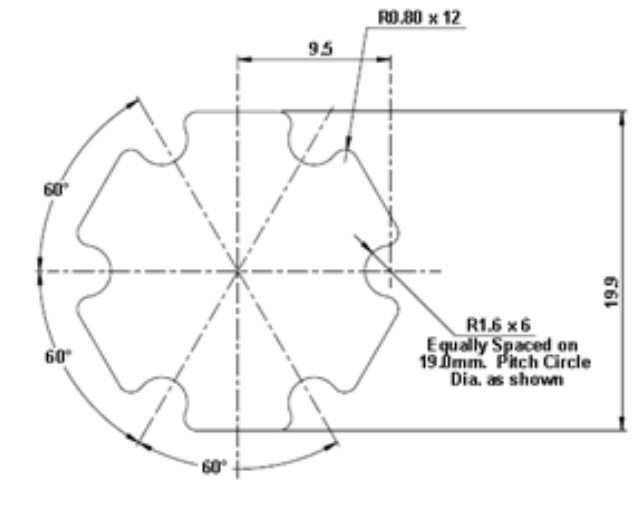
[LP][PCB type]/[##]-[XXX]-[T]-[#A]-[P]

PCB type	##	XXX	T	#A	P
LED Board No. LP0001 LP0002 etc	Variant 01	T-Global material Li98 Li98C Li2000 Li2000A	Thickness (mm) 0.06 0.012 0.12 etc	Adhesive 2A – two sided adhesive	Pull tab P

Example: LP0001/01-LI98-0.15

Single Star LED board

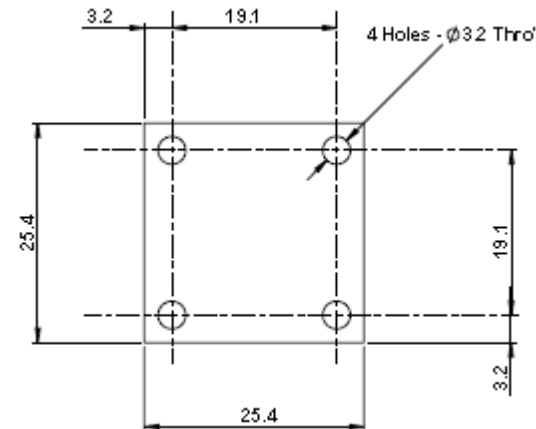
t-Global Part No.	LP0001/01-Li98-0.15	
Digi-Key Part No.	1168-1715-ND	
Description	Thermal tape	
Manufacturer	t-Global Technology	
Typical application	Thermal interface pad for LED Star board	
Material code	Li98	Unit
Thickness	0.15	mm
Reinforcement carrier	Fibreglass mesh	-
Features	Good thermal conductivity Good adhesion Easy to assemble	
Thermal conductivity	0.95	W/m.K
Thermal impedance @ < 1psi	1.0	°C /W
180° peeling strength (aluminium)	4	N/cm
Lap shear strength	61	N/cm ²
Die shear strength @ 25 °C	120	N/cm2
Operating temperature range	-30 to 120	°C
Holding power 1 Kg @ 25 °C using 1 in ²	>10,000	min
Tensile strength	200	Psi
Dielectric breakdown voltage (Vdc)	>3	kV
Colour	White	
Recommendations:		



Ordering Part No.	
t-Global	Digi-Key
LP0001/01-Li98-0.15	1168-1715-ND
LP0001/01-Li2000A-0.2	1168-1716-ND
LP0001/01-PC99-0.06	1168-1717-ND

LED board 25.4x25.4mm

t-Global Part No.	LP0002/01-Li98-0.15	
Digi-Key Part No.	1168-1718-ND	
Description	Thermal tape	
Manufacturer	t-Global Technology	
Typical application	Thermal interface pad for LED board	
Material code	Li98	Unit
Thickness	0.15	mm
Reinforcement carrier	Fibreglass mesh	-
Features	Good thermal conductivity Good adhesion Easy to assemble	
Thermal conductivity	0.95	W/m.K
Thermal impedance @ < 1psi	1.0	°C/W
180° peeling strength (aluminium)	4	N/cm
Lap shear strength	61	N/cm ²
Die shear strength @ 25 °C	120	N/cm ²
Operating temperature range	-30 to 120	°C
Holding power 1 Kg @ 25 °C using 1 in ²	>10,000	min
Tensile strength	200	Psi
Dielectric breakdown voltage (Vdc)	>3	kV
Colour	White	
Recommendations:		

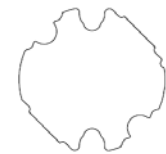
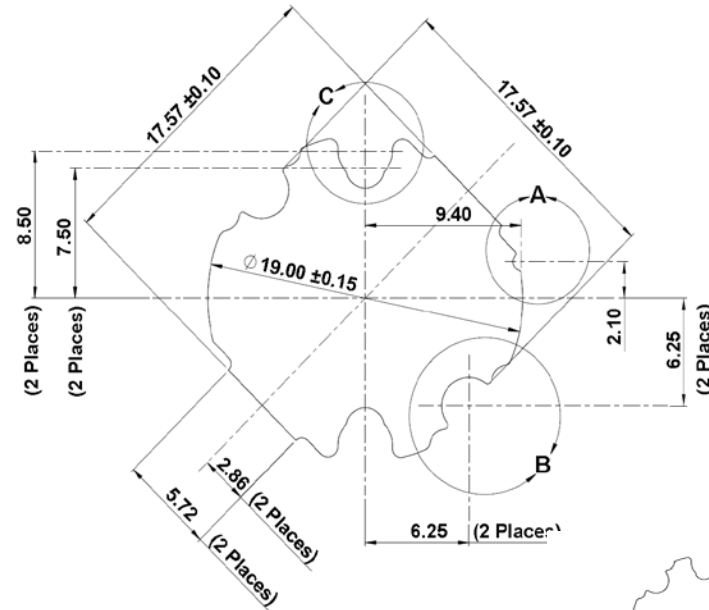


Ordering Part No.	
t-Global	Digi-Key
LP0002/01-Li98-0.15	1168-1718-ND
LP0002/01-Li2000A-0.2	1168-1719-ND
LP0002/01-PC99-0.06	1168-1720-ND

Luxeon LED Board LXK8-PWxx-0004



t-Global Part No.	LP0003/01-Li98-0.15	
Digi-Key Part No.	1168-1763-ND	
Description	Thermal tape	
Manufacturer	t-Global Technology	
Typical application	Thermal interface pad for Luxeon LXK8-PWxx-0004 LED board	
Material code	Li98	Unit
Thickness	0.15	mm
Reinforcement carrier	Fibreglass mesh	-
Features	Good thermal conductivity Good adhesion Easy to assemble	
Thermal conductivity	0.95	W/m.K
Thermal impedance @ < 1psi	1.0	°C /W
180° peeling strength (aluminium)	4	N/cm
Lap shear strength	61	N/cm ²
Die shear strength @ 25 °C	120	N/cm ²
Operating temperature range	-30 to 120	°C
Holding power 1 Kg @ 25 °C using 1 in ²	>10,000	min
Tensile strength	200	Psi
Dielectric breakdown voltage (Vdc)	>3	kV
Colour	White	
Recommendations:		



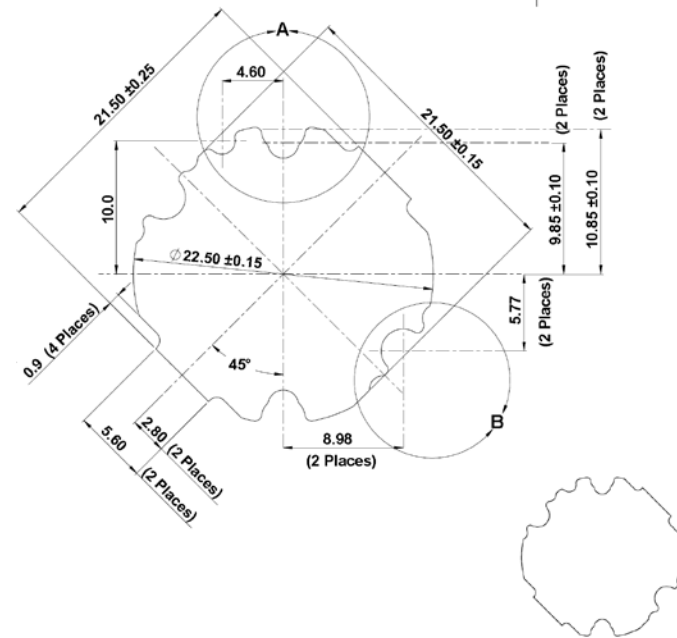
REFERENCE VIEW

Ordering Part No.	
t-Global	Digi-Key
LP0003/01-Li98-0.15	1168-1763-ND
LP0003/01-Li2000A-0.2	1168-1764-ND
LP0003/01-PC99-0.06	1168-1765-ND

Luxeon LED board LXK8-PWxx-0008



t-Global Part No.	LP0004/01-Li98-0.15	
Digi-Key Part No.	1168-1766-ND	
Description	Thermal tape	
Manufacturer	t-Global Technology	
Typical application	Thermal interface pad for Luxeon LXK8-PWxx-0008 LED board	
Material code	Li98	Unit
Thickness	0.15	mm
Reinforcement carrier	Fibreglass mesh	-
Features	Good thermal conductivity Good adhesion Easy to assemble	
Thermal conductivity	0.95	W/m.K
Thermal impedance @ < 1psi	1.0	°C /W
180° peeling strength (aluminium)	4	N/cm
Lap shear strength	61	N/cm ²
Die shear strength @ 25 °C	120	N/cm2
Operating temperature range	-30 to 120	°C
Holding power 1 Kg @ 25 °C using 1 in ²	>10,000	min
Tensile strength	200	Psi
Dielectric breakdown voltage (Vdc)	>3	kV
Colour	White	
Recommendations:		



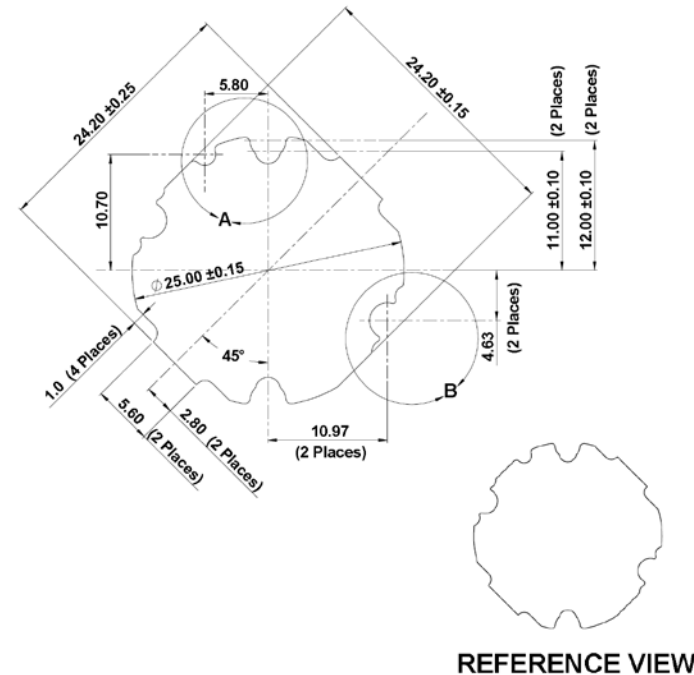
REFERENCE VIEW

Ordering Part No.	
t-Global	Digi-Key
LP0004/01-Li98-0.15	1168-1766-ND
LP0004/01-Li2000A-0.2	1168-1767-ND
LP0004/01-PC99-0.06	1168-1768-ND

Luxeon LED board LXK8-PWxx-0012 & 0016



t-Global Part No.	LP0005/01-Li98-0.15	
Digi-Key Part No.	1168-1769-ND	
Description	Thermal tape	
Manufacturer	t-Global Technology	
Typical application	Thermal interface pad for Luxeon LXK8-PWxx-0016 & 0012 LED board	
Material code	Li98	Unit
Thickness	0.15	mm
Reinforcement carrier	Fibreglass mesh	-
Features	Good thermal conductivity Good adhesion Easy to assemble	
Thermal conductivity	0.95	W/m.K
Thermal impedance @ < 1psi	1.0	°C /W
180° peeling strength (aluminium)	4	N/cm
Lap shear strength	61	N/cm ²
Die shear strength @ 25 °C	120	N/cm ²
Operating temperature range	-30 to 120	°C
Holding power 1 Kg @ 25 °C using 1 in ²	>10,000	min
Tensile strength	200	Psi
Dielectric breakdown voltage (Vdc)	>3	kV
Colour	White	
Recommendations:		

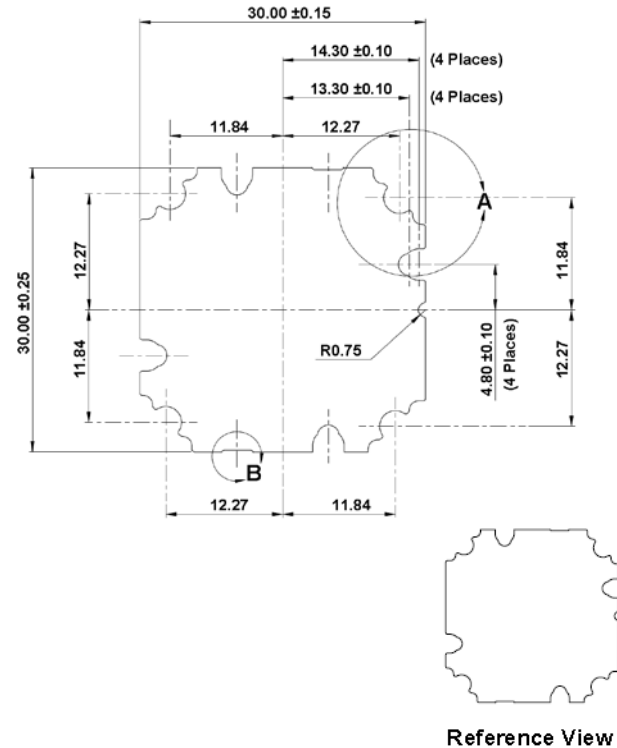


Ordering Part No.	
t-Global	Digi-Key
LP0005/01-Li98-0.15	1168-1769-ND
LP0005/01-Li2000A-0.2	1168-1770-ND
LP0005/01-PC99-0.06	1168-1771-ND

Luxeon LED board LKX8-PWxx-0024



t-Global Part No.	LP0006/01-Li98-0.15	
Digi-Key Part No.	1168-1772-ND	
Description	Thermal tape	
Manufacturer	t-Global Technology	
Typical application	Thermal interface pad for Luxeon LKX8-PWxx-0024 LED board	
Material code	Li98	Unit
Thickness	0.15	mm
Reinforcement carrier	Fibreglass mesh	-
Features	Good thermal conductivity Good adhesion Easy to assemble	
Thermal conductivity	0.95	W/m.K
Thermal impedance @ < 1psi	1.0	°C /W
180° peeling strength (aluminium)	4	N/cm
Lap shear strength	61	N/cm ²
Die shear strength @ 25 °C	120	N/cm ²
Operating temperature range	-30 to 120	°C
Holding power 1 Kg @ 25 °C using 1 in ²	>10,000	min
Tensile strength	200	Psi
Dielectric breakdown voltage (Vdc)	>3	kV
Colour	White	
Recommendations:		



Ordering Part No.	
t-Global	Digi-Key
LP0006/01-Li98-0.15	1168-1772-ND
LP0006/01-Li2000A-0.2	1168-1773-ND
LP0006/01-PC99-0.06	1168-1774-ND



Summary

- LED lighting is becoming increasingly more prevalent as global energy costs rise
- Thermal management of LED systems is critical for life-time, reliability, and colour stability
- Transferring heat from the LED to the heat sink is of critical concern and requires the use of a good thermal interface material
- T-Global technology makes the Li98 range of thermally conductive adhesives tapes which have been especially designed for thermal management in the LED and lighting industry