

Application Notes - UPF Series OptoCoolers

Handling, Mounting and Operating Guidelines

1. Introduction

The UPF series OptoCooler is a mechanically sensitive device and careful handling is required [Section 2]. The UPF OptoCooler must be properly attached to a heat sink [Section 4]. The UPF OptoCooler can be operated in forward or reverse polarity, to provide either cooling or heating for precise temperature control. The maximum applied current is 4.8A @ 85C.

2. Handling

Thin-film thermoelectric modules are, by design, extremely small compared to bulk thermoelectric modules. Careful handling is required to avoid damage. **Caution: The most common source of damage is caused by shear force applied to the Top Header [Figure 1].**

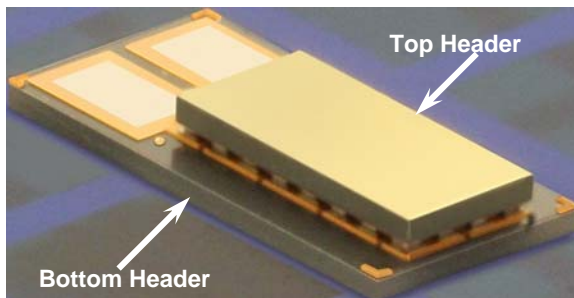


Figure 1

UPF40 module - Top and Bottom Headers

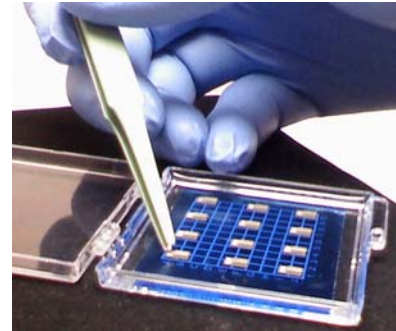


Figure 2

Place tweezers at Bottom Header [bond pad side] and Gelpak interface

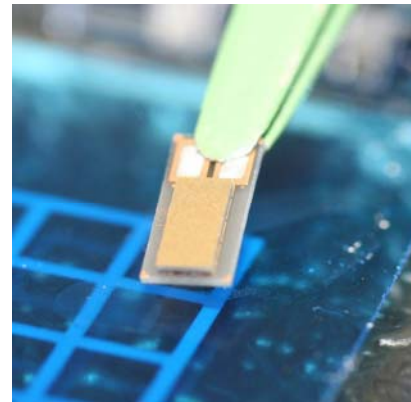


Figure 3

Close tweezers against Bottom Header underside and bond pads

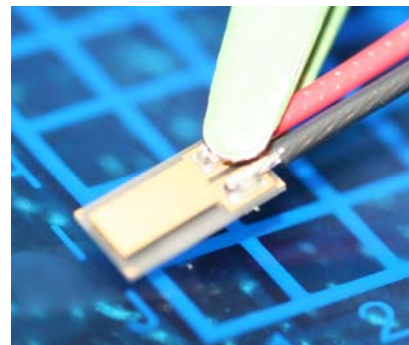


Figure 4

Lift module upward

Removal Instructions:

- Place tweezers at the Bottom Header and Gelpak interface [Figure 2] on the bond pad (or wire) end of the module
- Slowly and gently pry the Bottom Header away from the Gelpak
- Allow a few seconds for adhesive to release
- Close the tweezers against the Bottom Header underside and bond pads [Figure 3]
- Lift module upward [Figure 4]

3. Overview

The UPF OptoCooler's basic unit is a P-N couple, where the P and N elements are electrically connected in series [Figure 5]. When current is driven through the P-N couple, depending on current direction, heat absorbed on one side is pumped to the other side. The P and N are connected thermally in parallel.

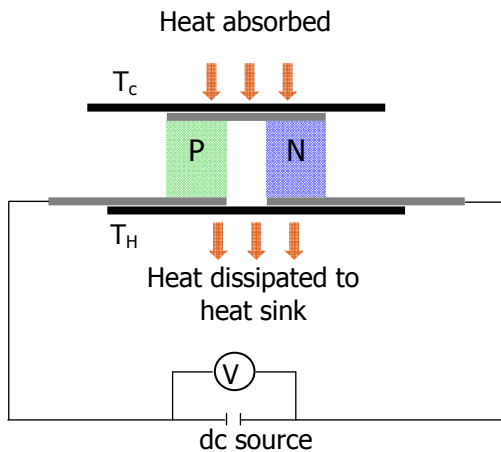


Figure 5
UPF Basic Unit: P-N couple

Two discrete thermoelectric modules have been developed using the UPF series technology: UPF4 [Figure 6] and UPF40 [Figure 7].

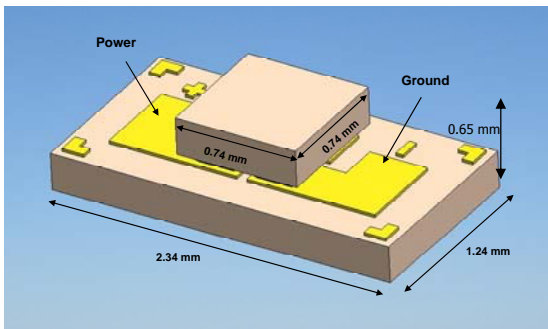


Figure 6
UPF4 - Dimensioned Perspective

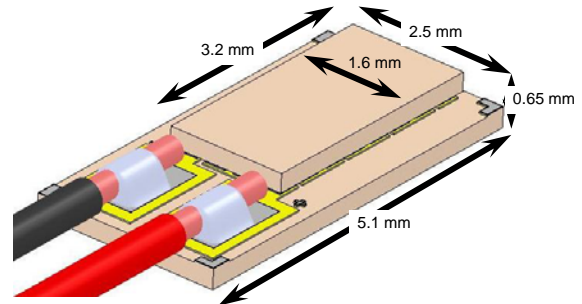


Figure 7
UPF40 - Dimensioned Perspective

4. Attaching Heat Sink and Heat Source

Figure 8 illustrates a UPF module in a typical cooling mode setup. Top and Bottom headers are aluminum nitride [AlN]. Heat is injected into the Top Header and rejected out of the Bottom Header.

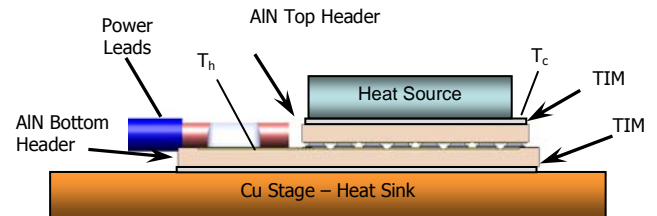


Figure 8
UPF40 - Cooling Mode Setup

Recommended Thermal Interface Materials (TIM):

- 1 Liquid metal [*e.g.*, GaSn]
- 2 Low melting point solder preform [*e.g.*, InSn 118°C]

Note: Avoid use of thermal greases or epoxies as thermal interface materials, as these products do not provide adequately low thermal resistance paths for the heat.

Heat Sink

Attach the Bottom Header underside to the Heat Sink.

If using GaSn:

- 1 Apply to surface of heat sink and to underside of module Bottom Header
- 2 Seat module into GaSn using tweezers on the sides of the Bottom Header

Cautions:

- Do not apply excess GaSn, as risk thermal shunting of Top Header to Bottom Header, severely degrading module performance.
- Do not push on Top Header

If using solder preform:

[Note: Both Bottom and Top Headers have a thin gold layer to facilitate solder attachment]

- 1 Apply flux to Heat Sink and Bottom Header underside per solder specification
- 2 Seat solder preform in flux on Heat Sink
- 3 Set module on solder preform
- 4 Reflow solder, work module into solder pool
Caution: Do not exceed 120°C reflow for module with wires attached, or 150°C for module without wires
- 5 Remove flux per solder specification

Heat Source

Attach Heat Source [*i.e.*; *the object to be cooled*] to Top Header.

If using GaSn:

- 1 Apply to Top Header and underside of Heat Source
- 2 Gently place Heat Source on Top Header

If using solder preform:

- 1 Apply flux to Heat Source and Top Header per solder specification
- 2 Seat solder preform in flux on Top Header
- 3 Set Heat Source on solder preform
- 4 Reflow solder
- 5 Remove flux per solder specification

5. Operating Instructions

Use a dc power supply with <10% ripple (e.g., Agilent E3633A DC Power Supply) as the UPF OptoCoolers are current controlled devices.

Power Supply Connections

Module	Cooling ¹
with wires	red wire: "+" bias ²
without wires	"+" bond pad: "+" bias

¹ Heating mode requires a reverse bias

² Black wire or "-" bias same as ground

Apply voltage and current according to performance curves [load lines] in UPF Data Sheet. Maximum efficiency (Coefficient of Performance, COP) occurs at levels below the maximum current and voltage ratings. For normal cooling operation, power the module only at currents below I_{max} ; that is, in the region where ΔT and Q_{load} are positive for each load condition. The current for optimal COP typically is 25% – 35% of I_{max} .

Operating Conditions - Summary

Condition	Operation
Maximum Cooling	I_{max}
Normal Cooling	Below I_{max}
Optimal COP	25-30% of I_{max}

Caution: Do not exceed 120°C T_{HOT} for module with wires attached, or 150°C for module without wires [*e.g.*, wire bonded]