Application Notes

HV14 OptoCooler

NCA-1101443-0202A_A (gold wire bond compatible)

Extraction from a Gelpak

Tweezer contact with the top header of the HV14 module should be avoided.

Typical laboratory tweezers with large tweezer blades are not compatible with extracting HV14 modules. Referring to Fig. 1, it is obvious that the tweezer blades are larger than the HV14 module and are improperly sized for extraction and handling. Fine-tipped tweezers with small, pointed blades are better suited for extracting HV14 modules. Referring to Fig. 2, the size of the tweezer tip relative to the size of the HV14 is commensurate for extraction and handling.

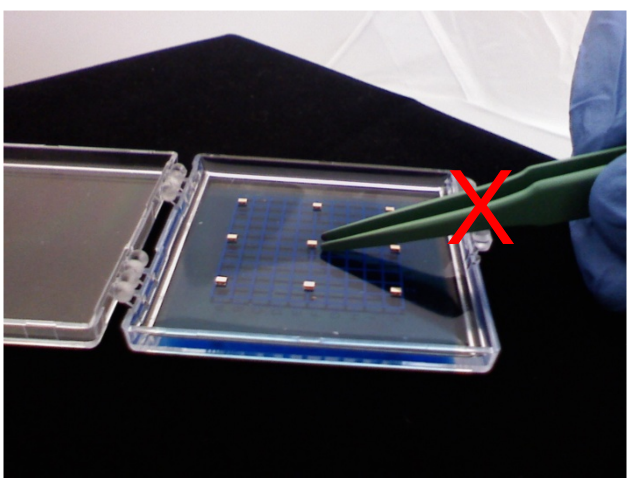

Fig. 1
Typical Teflon-coated laboratory tweezers with large tweezer blades

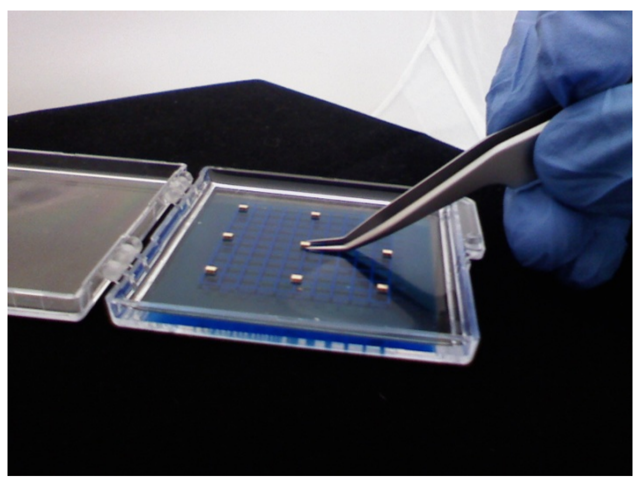

Fig. 2
Fine-tipped tweezers with small, pointed blades

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Extraction from a Gelpak, continued

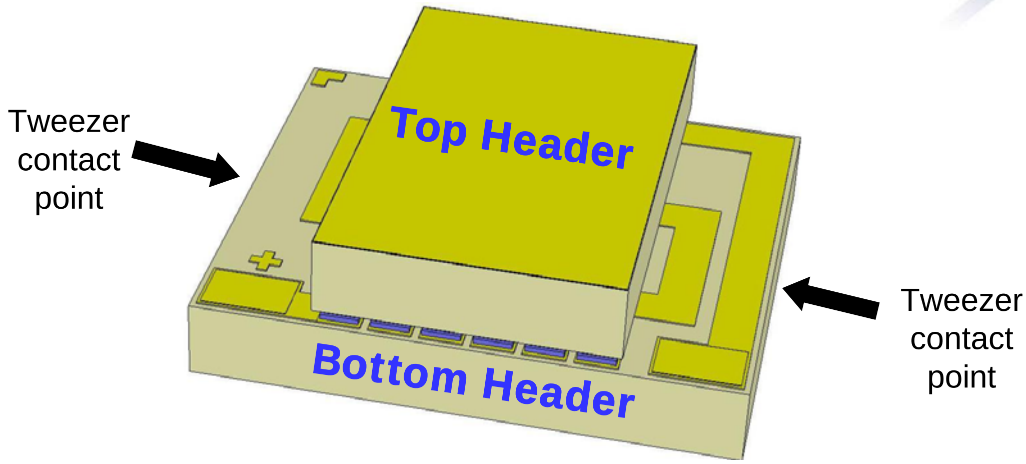

Fig. 3
Locations of Top & Bottom Headers and tweezer contact points

The extraction technique from the medium tack adhesive is as follows:

1. Straddle the HV14 module with the fine-tipped tweezers [Part ID: TDI 5C-SA Precision Tweezer] [Fig. 2]
2. Establish contact between the bottom surface of the blades and the adhesive surface [Fig. 2]
3. Squeeze the tweezers and make contact with only the bottom header of the module only in the locations shown in Fig. 3.
4. Slightly rotate the HV14 module to loosen the adhesive [Fig. 4]
5. Lift the HV14 module upward [Fig. 5]

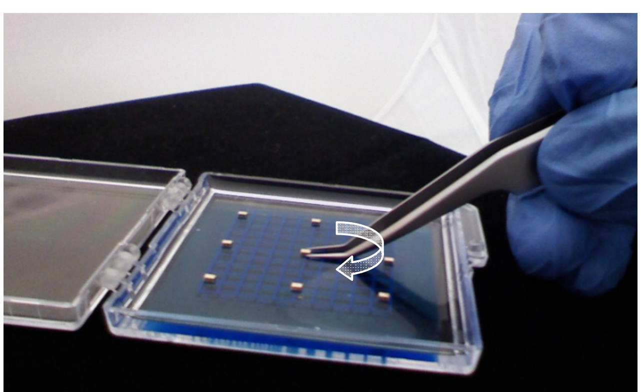

Fig. 4
Slight twist

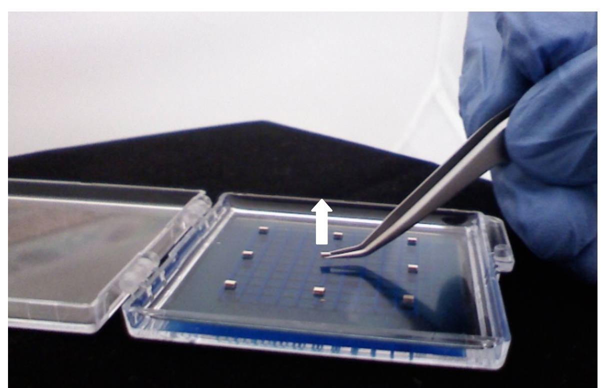

Fig. 5
Lift upward

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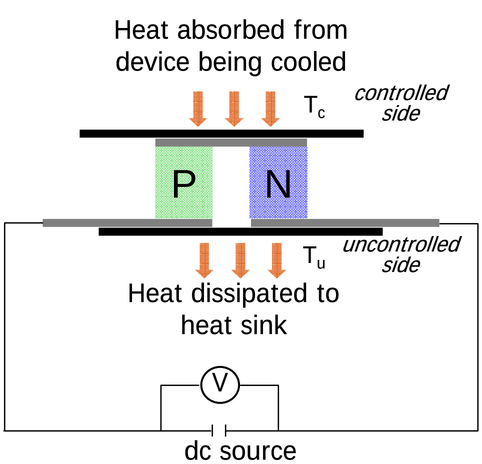
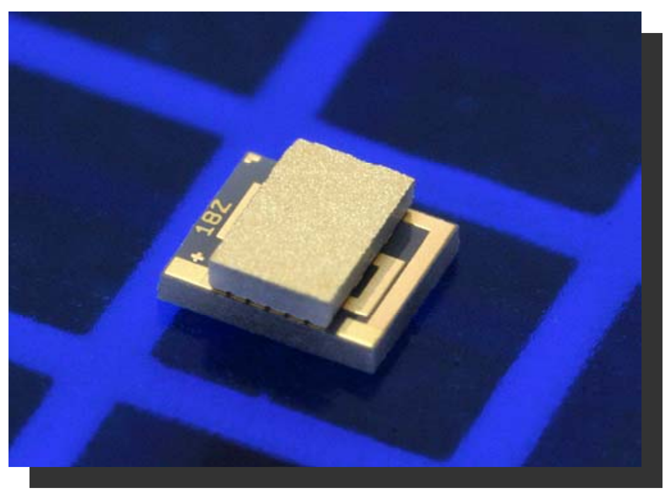
HV14 OptoCooler
Part Description and Features

Nextreme's HV series is a family of miniature heat pumps. The HV14 OptoCooler is a high-performance, solid-state embedded thermoelectric component (eTEC) optimized for high heat density cooling (<87 W/cm^2) and is ideally suited for optoelectronics and sensor applications. In addition, the HV14 OptoCooler can be operated in forward or reverse polarity to provide either cooling or heating for precise temperature control.





HV14 OptoCooler

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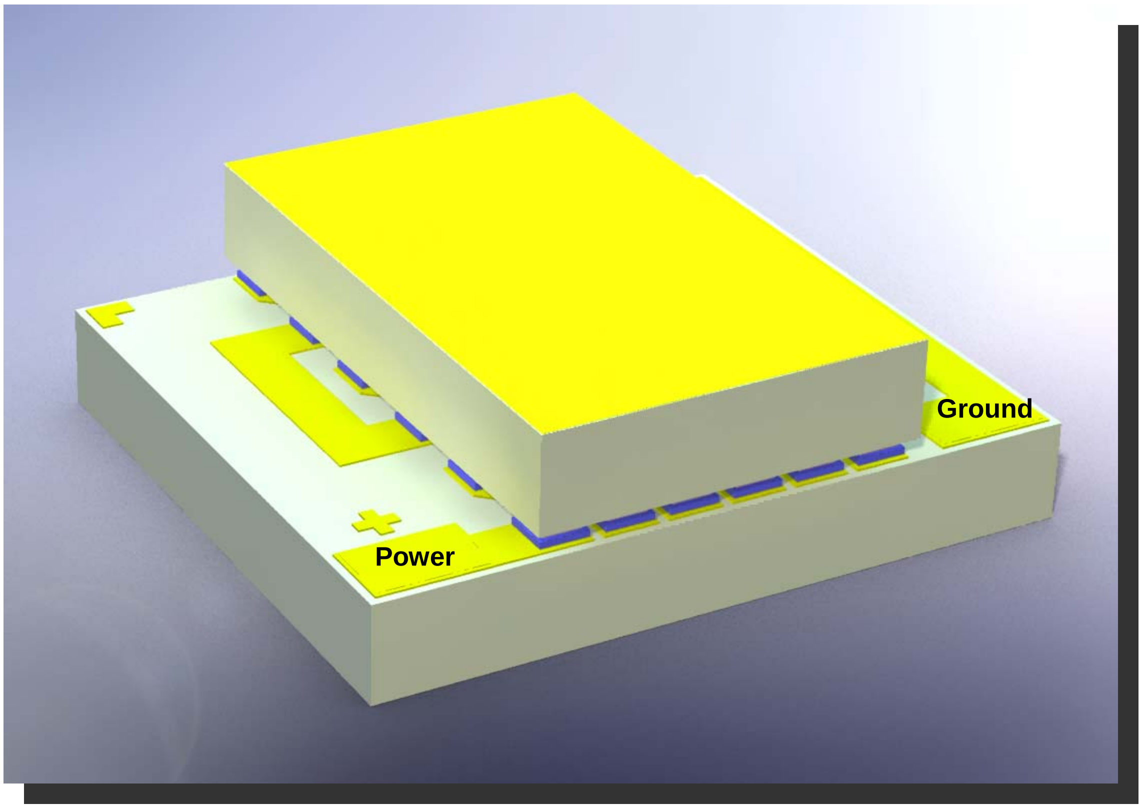
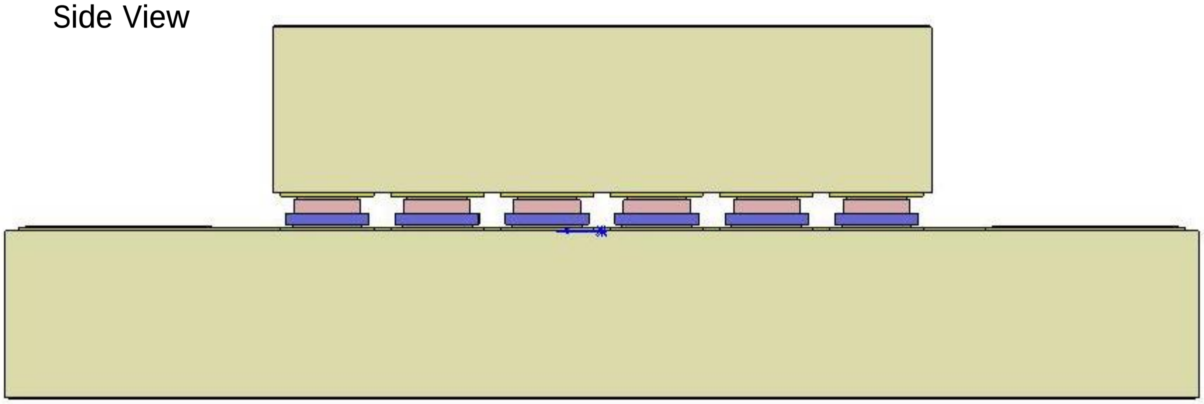
HV14 OptoCooler
Drawings

Perspective View



Side View



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HV14 OptoCooler
General Operating Instructions

- Do not operate device beyond maximum operating conditions (i.e., I_{max} or V_{max})
- Operate using dc power only with minimal ripple (<10%). The device may be powered for example by an Agilent E3633A DC Power Supply.
- Do not operate without a heat sink on the bottom header of the module. The temperature of the hot side of the bottom header when cooling, or of the top header when heating should **not exceed 200°C**.
- For optimal performance, the thermal resistance of the interfaces on each side of the HV14 should be minimized. The use of high quality thermal materials and thin bond lines (< 4mils) to provide a thermal path for heat rejection is recommended. High conductivity thermal interface materials (TIMs) include liquid metal alloys (GaSn), low temperature solders (InSn, BiSn) or thermal grease (Shin-Etsu G751). The use of a liquid metal alloy or low temperature solder is recommended on the hot side of the TEC (the side in which the heat is rejected).
- Care should be taken to prevent the thermal interface material from penetrating into the module interior. Do not apply excess TIM.
- Care should be taken to minimize normal or shear forces on the top header of the HV14 during assembly and test.
- For proper operation in the cooling mode, the positive wire pad marketed "+" should receive positive bias and the negative wire pad marked "-" negative or grounded.
- Voltage and current may be applied according to performance curves (load lines) as depicted in the specification sheet, which shows ΔT and COP as a function of applied current and heat load.
- The maximum efficiency, as determined by Coefficient of Performance (COP) testing, will occur at levels below the maximum current and voltage ratings.
- For normal cooling operation, the device should be powered at currents below I_{max}, in the region where ΔT and Q_{load} are positive for each load condition. The current for optimal COP is typically in the range of 25% – 35% of I_{max}.

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HV14 OptoCooler
Assembly for eTEC Testing

- The following procedure describes the techniques a customer may use to test the Nextreme eTEC for their application. Figure 6 depicts a typical eTEC assembly.
- For best results, the chip or heat source that is to be cooled should be mounted to the top header. The chip or heat source is typically referred to as the "Device Under Test" or DUT.
- The DUT should be of similar size or smaller (in footprint) than the top header dimensions.
- The following is a recommended sequence for assembly:

    1. Attach the HV14 to the cold plate or heat sink using a thermal interface material (TIM 2).
        a) The recommended TIM for this attachment is either a lot temperature solder (e.g., BiSn, InSn, In) or a liquid metal like GaSn.
        b) These TIMs provided the lowest thermal resistance and ensure good thermal rejection during operation.
    2. Attach the DUT to the top of the HV14 top header.
        a) Grease or conductive epoxy can be used for this (TIM 1). Be careful not to apply excessive grease or epoxy to avoid incursion into the TEC. If grease or epoxy are used, a thickness of 4 mils or less is recommended for optimal performance.
        b) Apply downward pressure to set chip into the TIM.
        c) Follow recommended curing instructions for the TIM (if required) being careful not to exceed 200°C.
    3. Apply electrical probes to positive and negative pads using micro-manipulators. Connect these to the power supply.
    4. (OPTIONAL) Place thermocouples on the top and bottom headers of the HV14. These can be applied using a very small amount of thermal grease. Be careful not to apply excessive grease to avoid incursion into the TEC.

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HV14 OptoCooler
Assembly for eTEC Testing

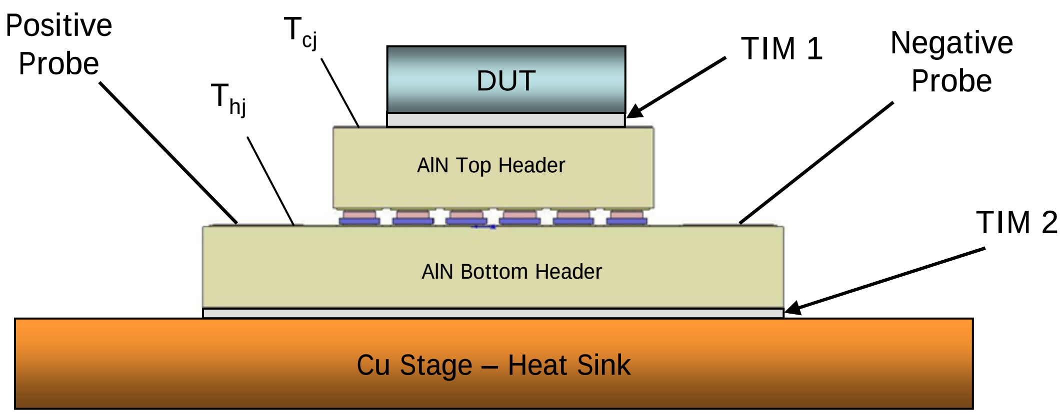

Figure 6 – eTEC Assembly

HV14 OptoCooler
Definitions

Parameter	Definitions
COP	Coefficient of Performance = Q_{load}/P_{in}
I_{max}	Current producing Q_{max}, the maximum heat pumping, or ΔT_{max}, the maximum temperature difference
P_{in}	Module input power defined by input (external) V and I
Q_{max}	Maximum achievable Q, occurs under ΔT = 0°K condition
Q_{load}	Heat pumped at a given condition
T_{hj}	Temperature of hot junction
T_{cj}	Temperature of cold junction
ΔT_{max}	Maximum achievable ΔT, occurs under no-load (Q = 0 W) condition
V_{max}	Maximum terminal voltage, occurs at ΔT_{max} condition

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