

W A T L O W

# ULTRAMIC™ 600

## ADVANCED CERAMIC HEATER

ULTRA-FAST RAMP RATES

HIGH WATT DENSITIES

NON-CONTAMINATING



# The Revolutionary ULTRAMIC™ 600

Watlow's ULTRAMIC™ 600 heaters are designed for thermal applications where the high performance of an advanced ceramic heater is required to ensure optimal effectiveness of the equipment and process.

ULTRAMIC 600 heaters are constructed of aluminum nitride (AlN) and incorporate a thermally matched proprietary heating element that provides maximum performance in challenging applications. AlN is especially suitable for applications requiring a **clean, non-contaminating** heat source. Additionally, the **excellent geometric stability** ensures consistent part-to-part thermal contact during heating cycles.



Watlow AlN heaters can operate up to **600°C with an ultra-fast ramp rate of up to 150°C per second** depending on the application, heater design and process parameters. In addition to excellent thermal characteristics, the ULTRAMIC 600 has **high electrical isolation** and typically provides **superior chemical resistance** as compared to traditional metal heaters.



## Robust AlN ceramic

- Creates a homogeneous assembly for atmospheric and vacuum applications
- Provides durable heater construction and thermal transfer necessary for high temperature and long heater life
- Permits the design of a high watt density, fast responding, heater in a very small package
- Geometrically stable due to low coefficient of thermal expansion (CTE)
- Process temperatures up to 600°C (1112°F) depending on application parameters

## Thermocouple integrated into assembly (patent pending)

- Bonded assembly process ensures reliability of heater/sensor interface
- Optimized temperature sensing improves accuracy
- High response rate in ramping applications

## Rapid prototyping

- Finite Element Analysis (FEA) provides rapid 'virtual' prototyping of heater performance prior to the manufacturing process
- Custom prototypes can be delivered in weeks rather than months with innovative design and manufacturing practices

## UL® agency compliance (pending)

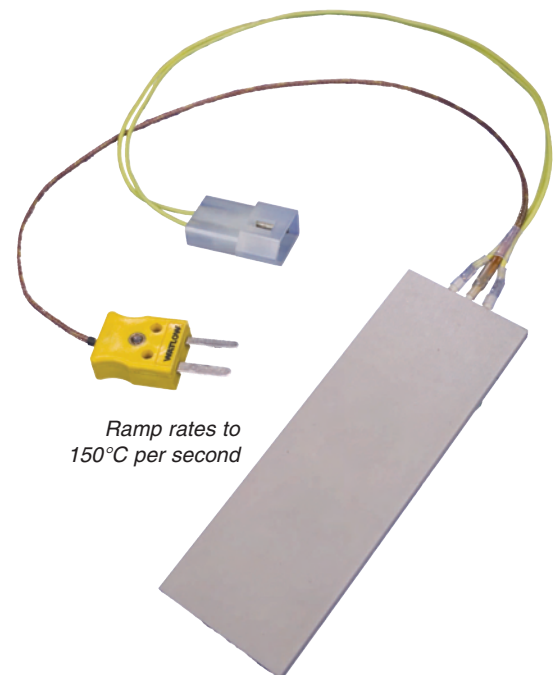
- Designed to meet global safety standards

## Superior electrical performance

- Low leakage current; <10 µA at 100°C
- Breakdown voltage; >2000V<sub>rms</sub>(dc)

## High thermal conductivity

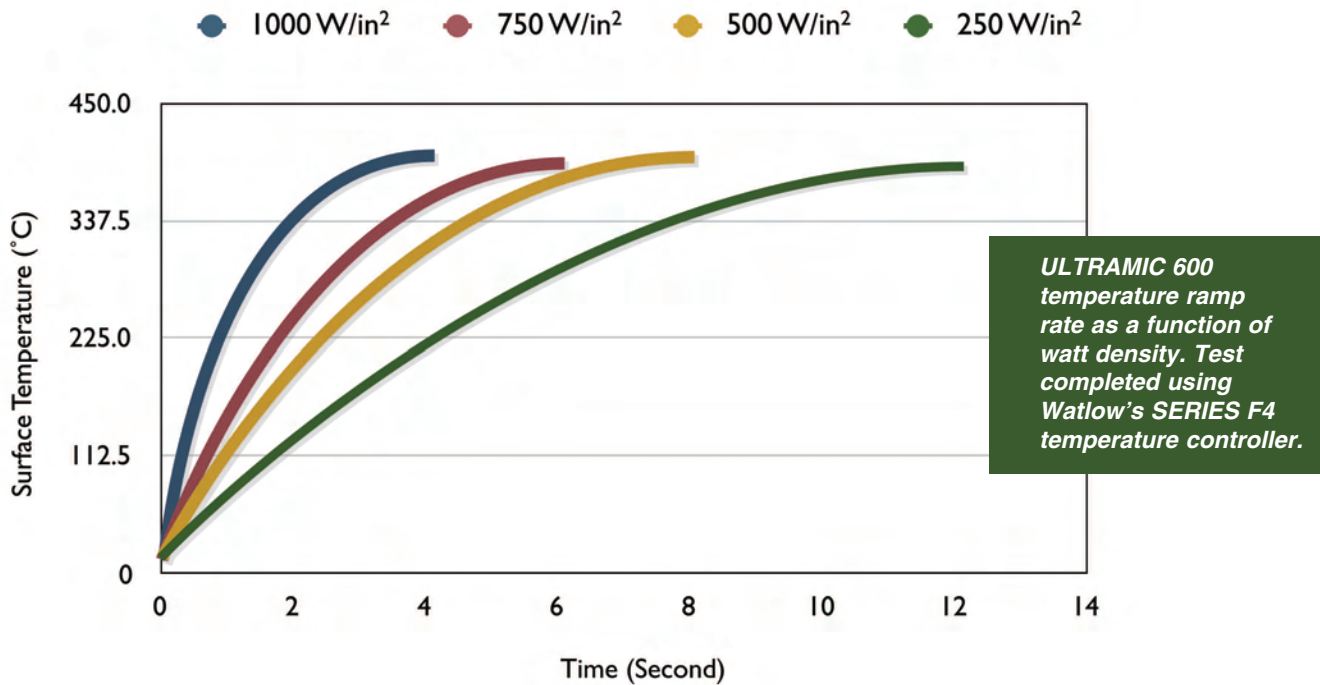
- Makes for a fast temperature ramp rate of up to 150°C (270°F) per second (depending on application parameters)
- Allows for quick cool-down
- Provides extremely uniform temperatures over the heater surface



Ramp rates to  
150°C per second

UL® is a registered trademark of Underwriter's Laboratories, Inc.

# ULTRAMIC™ 600 Temperature Ramping Capabilities



## Application Examples

### Semiconductor Equipment

Eutectic die bonding equipment is used in the attachment of lead wires to the die before packaging of the IC. Optimum bonding is achieved by ramping the solder and lead temperature through the eutectic state. Watlow's ULTRAMIC 600 heater is ideal for this application because a temperature ramp of up to 150°C/second can be achieved while also achieving a fast cool down in preparation for processing the next device.

- Temperature ramp rate to 150°C (270°F)/sec
- Vacuum holes and grooves
- Surface flatness 0.05 mm (0.002 in.)
- Surface finish <0.8 µm (32 µ-in.)

### Analytical Instrumentation

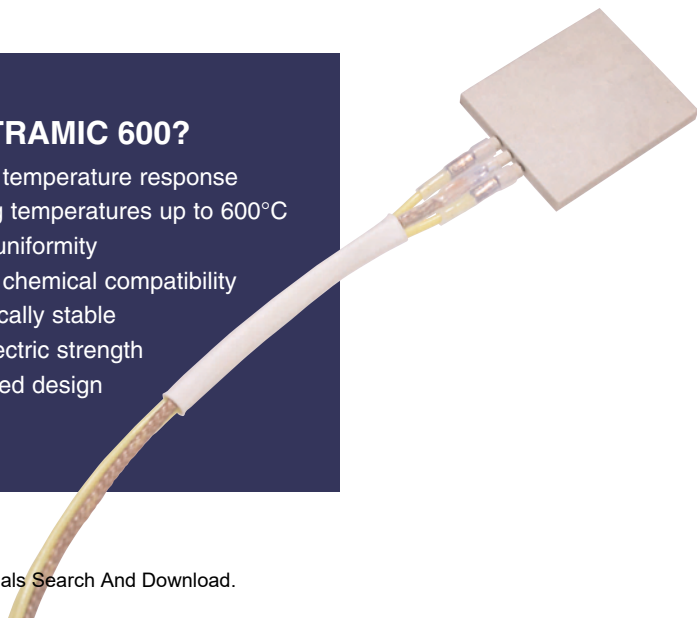
Mass spectrometers are used to determine the presence of trace chemicals in industrial, environmental and clinical applications. With detection capabilities into the part-per-trillion levels, cleanliness is of paramount concern. For use with ion sources, the chemical compatibility, low porosity and fine surface finish make the ULTRAMIC 600 an excellent choice where contamination of the sample is of concern.

- Process temperatures to 600°C (1112°F)
- Chemical compatibility
- High dielectric strength
- Small size and light weight



## Why ULTRAMIC 600?

- Ultra-fast temperature response
- Operating temperatures up to 600°C
- Thermal uniformity
- Excellent chemical compatibility
- Geometrically stable
- High dielectric strength
- Customized design

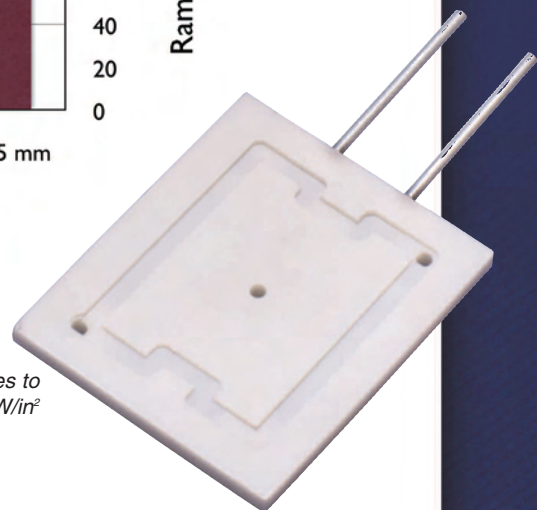
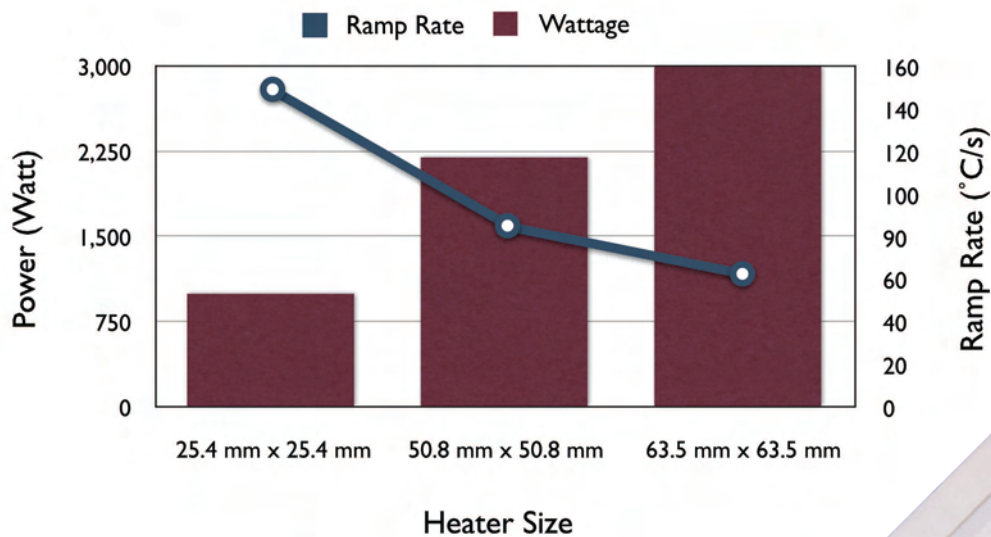


Configurations and Dimensions				
Maximum Dimensions 4032 mm <sup>2</sup> (6.25 in <sup>2</sup> )				
	Length	Width	Thickness	Aspect Ratio
Flat Square	Min: 8 mm (0.314 in.) Max: 63.5 mm (2.5 in.)		Min: 2 mm (0.078 in.) Max: 5 mm (0.196 in.)	1
Rectangular	Max: 100 mm (3.94 in.)	Min: 8 mm (0.157 in.)	Min: 2 mm (0.078 in.) Max: 5 mm (0.196 in.)	<10
	Inside Diameter (I.D.)	Outside Diameter (O.D.)	Thickness	Ring Wall Thickness
Ring	Min: 3 mm (0.118 in.)	Max: O.D. 75 mm (2.95 in.)	Min: 2 mm (0.078 in.) Max: 5 mm (0.196 in.)	Minimum wall thickness: 3 mm (0.118 in.)
Surface Finish				
Flatness	Parallelism	Surface Roughness (Ra)	Straight Groove Custom Feature	Hole Size Round Diameter
<0.05 mm (0.002 in.)	<0.05 mm (0.002 in.)	<0.8 μm (32 μ-in.)	Depth: 0.20 - 0.5 mm (0.019 in.) Width: 0.75 - 2 mm (0.078 in.)	Min: 1 mm (0.039 in.) Max: Outer edge 3 mm (0.118 in.)
Electrical Properties				
Voltage	Leakage Current	Dielectric Constant	Dielectric Strength	
24 to 480V	<0.1mA	8.9	15KV/mm	

## Ramp Rate vs. Wattage

### Power density

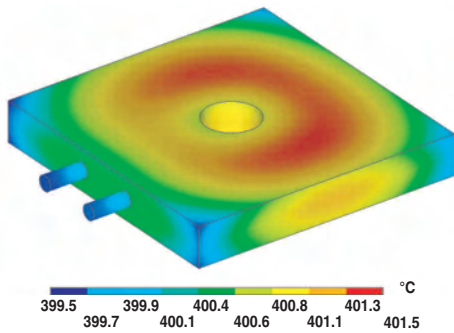
Maximum and minimum power densities can vary with voltage, surface area and application parameters. The following graph is meant as a guideline. Contact factory to determine optimum voltage and power for your application.



Watt densities to  
1000W/in<sup>2</sup>

# Sintered Ceramic Heater Construction

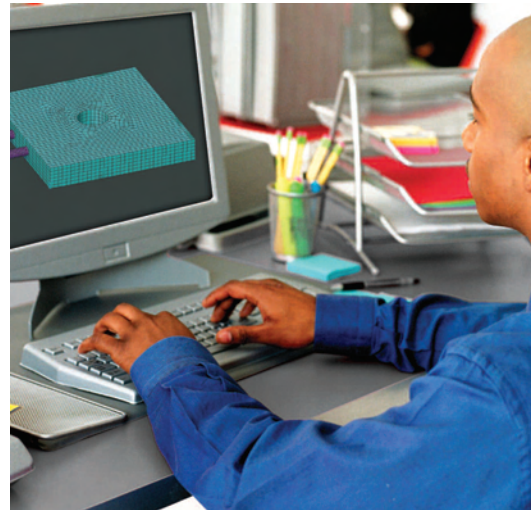
ULTRAMIC™ 600 heaters are manufactured using a proprietary sintering process. Sintering is a method where aluminum nitride (AlN) ceramic powder is heated at a high temperature, which allows contacting particles to diffuse together. This process creates a monolithic, geometrically stable structure with very low porosity.



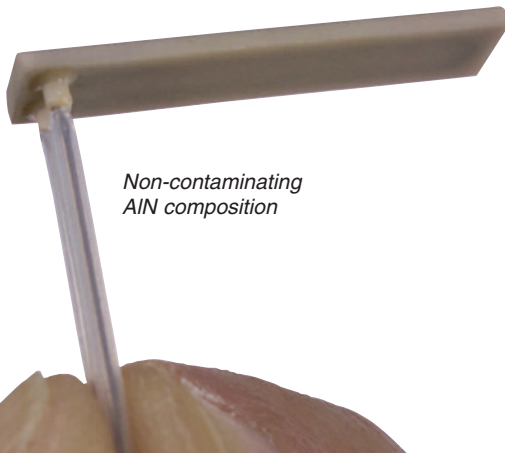
The high thermal conductivity of AlN and an optimized circuit layout combine to produce superb temperature uniformity across the heater surface.



The AlN matrix is constructed of two parts. The heating element is printed on one of the AlN parts. Then, the parts are sintered together, making them one homogeneous assembly.



Custom designs can be rapidly accommodated including those with complex topographies such as holes, notches and vacuum grooves. Using a Finite Element Analysis (FEA) technique, the heater circuit is optimized and the thermal performance simulated prior to manufacture.



Non-contaminating AlN composition

ULTRAMIC 600 Thermal and Physical Properties			
AlN			
Thermal Properties		Physical Properties	
Thermal Conductivity (W/mK)	140	Density (g/cm <sup>3</sup> )	3.26
CTE (ppm/°C)	4.5	Hardness (Hv@500g)	1050
Surface Temperature	600°C (1112°F)	Flexural Strength (MPa)	>250
Terminal Temperature	400°C (752°F)		

## Mounting Guidelines

- Temperature <200°C (392°F): bond with high-temperature epoxy adhesive
- Temperature >200°C (392°F): screw hole can be provided (recommend insulation buffer such as mica spacer)
- Clamp using single or multiple-point fasteners

## Optional Thermocouple

- Bonded bare wire Type K thermocouple with ceramic insulation for <400°C (752°F)
- Drilled hole can be provided for installing a sheathed thermocouple for <600°C (1112°F)

## Lead Wire and Terminations

- Power terminals exit locations - extended from side on square and rectangular shapes and from the top on the ring shapes
- Flexible lead extension
  - Teflon® insulated silver-plated copper lead extension
  - Lead extension length - standard length 305 mm (12 in.)

## How to Order

To order your standard ULTRAMIC 600 heater, please specify Watlow code number.

If our standard units do not meet your application needs, Watlow can rapidly manufacture the ULTRAMIC 600 to your special requirements. For made-to-order units, please consult the factory.

## Availability

Standard heaters are available for shipment in seven business days or less. While normally customized for the application, these products enable a development engineer to quickly and easily acquire a test sample to determine its suitability in the application.

**Custom configurations involving grooves, holes, product size or surface finishes are routinely manufactured to meet the exact requirements of the design engineer.** Delivery is dependent on complexity of order. Please consult factory.

## Standard Product Ordering Information

Code Number	Size	Watts	W/in <sup>2</sup>	(W/cm <sup>2</sup> )	Voltage V~(ac)
<b>Square ①</b>					
CER-1-01-00002	25 mm x 25 mm x 2.5 mm (0.98 in. x 0.98 in. x 0.1 in.)	967	1000	(155.04)	240
CER-1-01-00006	50 mm x 50 mm x 2.5 mm (1.97 in. x 1.97 in. x 0.1 in.)	1938	500	(77.52)	240
CER-1-01-00093	25 mm x 25 mm x 2.5 mm (0.98 in. x 0.98 in. x 0.1 in.)	150	150	(24)	120
CER-1-01-00097	19 mm x 19 mm x 2.5 mm (0.75 in. x 0.75 in. x 0.1 in.)	200	357	(55.56)	120
<b>Rectangular ①</b>					
CER-1-01-00001	25 mm x 15 mm x 2.5 mm (0.98 in. x 0.6 in. x 0.1 in.)	580	1000	(155.04)	120
CER-1-01-00003	50 mm x 10 mm x 2.5 mm (1.97 in. x 0.39 in. x 0.1 in.)	582	750	(116.28)	120
CER-1-01-00004	50 mm x 10 mm x 2.5 mm (1.97 in. x 0.39 in. x 0.1 in.)	770	1000	(155.04)	240
CER-1-01-00005	50 mm x 25 mm x 2.5 mm (1.97 in. x 0.98 in. x 0.1 in.)	1453	750	(116.28)	240
CER-1-01-00007	75 mm x 25 mm x 2.5 mm (2.95 in. x 0.98 in. x 0.1 in.)	1455	500	(77.52)	240
CER-1-01-00098	25 mm x 15 mm x 2.5 mm (0.98 in. x 0.6 in. x 0.1 in.)	180	305	(48.0)	120
CER-1-01-00105	50 mm x 25 mm x 2.5 mm (1.97 in. x 0.98 in. x 0.1 in.)	100	50	(8)	120
<b>Ring ②</b>					
CER-1-02-00001	38 mm O.D./29 mm I.D. (1.50 in. O.D./1.14 in. I.D.)	733	1000	(155.04)	120
CER-1-02-00002	77.5 mm O.D./59 mm I.D. (3.05 in. O.D./2.32 in. I.D.)	770	250	(38.76)	240

① Leads exit short side

② Leads exit top

Standard configurations include:

- Power lead wires with Teflon® insulation 305 mm (12 in.)
- Bonded Type K thermocouple with 305 mm (12 in.) Teflon® insulated lead extension
- Surface finish (Ra) <0.8 µm (32 µ-in.)

Teflon® is a registered trademark of E.I. du Pont Nemours & Company.

FEN-ULT-1007

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