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# HeatWave Model VIA-301

## Data Sheet

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### General Description



This HeatWave generator system uses a CPI manufactured Gyrotron, designed for industrial/scientific service, as the energy source. By using the 28-GHz, 10 kW CW Gyrotron in combination with modern control and power-supply technology, CPI is able to furnish a compact, user-friendly, cost-effective microwave generator system.

The system's control center employs an embedded microprocessor, which provides flexibility in selecting system operating parameters. Operation can be initiated by a simple "on" command. A fully manual operation is included as well. Provisions are included to permit remote operation and monitoring via RS-232 and/or Ethernet connection.

By using a switch-mode power supply to provide the beam power for the Gyrotron, this system achieves low power-supply ripple without using large filter capacitors, thereby eliminating the need for a costly crowbar to protect the Gyrotron. The compact power supply makes it possible to offer a system housed in a single three-bay cabinet approximately 1.8 meters wide, 1.0 meters deep and 2.0 meters high weighing approximately 1,300 kg.

## **INSTRUMENTATION AND CONTROL**

All operating, and control functions will be performed by the control-center. Critical interlocks, such as those required for system or personnel safety are hard-wired.

## **CABINETY**

The system is installed in a standard three-bay cabinet as shown in the VIA-301 HeatWave Generator Picture on page 1.

## **WAVEGUIDE SYSTEM**

The Gyrotron oscillates in the  $TE_{02}$  mode at 28 GHz. To provide low loss, the output waveguide is oversized (1.281 inch - 32.5 mm inside diameter). The use of oversized waveguide results in overmoded operation. Fourteen TE and ten TM modes can propagate in WRC621D14 at 28 GHz. As long as the Gyrotron output is connected to a straight WRC621D14 guide the output will be in excess of 95%  $TE_{02}$  single mode. Bends or perturbations in the waveguide will cause conversion to other modes unless carefully designed. The directional coupler is designed to respond to only the  $TE_{02}$  mode so that unambiguous measurements can be made in systems with significant non  $TE_{02}$  reflected energy. While the Gyrotron is not harmed by reflected  $TE_{02}$  energy,  $TE_{21}$  and  $TE_{11}$  reflections can cause damage to the tube structure from overheating. CPI offers a mode absorber to protect the Gyrotron where such reflections are expected.

For systems that use other than a multimode cavity applicator, CPI offers the system designer waveguide and applicator components, such as low-mode-conversion waveguide bends, focusing mirrors, arc-detectors and barrier windows. A converter from  $TE_{02}$  to  $TE_{01}$  mode is a standard product and efficient converters to other modes can be supplied.

## **Physical Description**

The HeatWave generator has internal fans that are provided to cool certain internal components and there are vents in the cabinet to allow a flow of cooling air through the cabinet. The cabinet is designed to allow the HeatWave to be moved with a forklift or pallet jack for initial placement in the laboratory where it will be used.

It is advisable to level and secure the unit once the final location has been established. The HeatWave generator should be evenly supported at its base for proper load distribution.

## **RF Output**

The RF output waveguide connection is brought out through the top or side or front or back of the cabinet on the left end of the HeatWave system. Care should be exercised when connecting the waveguide run to avoid stresses on the output flange. The mating assembly should be aligned in all 3 axes prior to the flanges being bolted or clamped together.

## **CAUTION**

Foreign material and moisture in the waveguide can cause destructive arcing. Whenever a waveguide joint is opened, take extreme care to keep foreign material and moisture from entering the waveguide.



## VIA-301 Physical Features

### Safety Features

Strong magnetic fields are present inside the unit. However, there is sufficient shielding in the system to reduce the strength external to the cabinet to safe levels. The panels on the cabinet are interlocked for personnel safety. If any panel is removed the shunt-trip main circuit breaker will disconnect the HeatWave system from the prime power source.

An EMERGENCY OFF button is mounted in the center bay of the system. Pushing this button energizes the main circuit breaker shunt trip coil, which removes all power from the HeatWave. There are provisions for the user to connect additional emergency off button-switches to the HeatWave system. Since the push-button activates the main circuit breaker shunt trip circuit, approximately 50 to 100 milliseconds are required for power removal after the button is pushed.

The HeatWave includes protection necessary to cope with internal faults as well as operator errors pertaining to the HeatWave operation. It also includes protection of the generator from arcs generated in the external waveguide system as well as from excessive reflected energy from the external waveguide system.

The HeatWave generator includes provision for external interlocks to remove gyrotron beam voltage. The purpose of the external interlocks is to ensure that the user's system safety interlock turns off the generator if a hazardous situation arises. Hardwired shutdown logic sends a command to turn off the RF in a few tens of milliseconds after receiving the command.

## Specifications

### Electrical

Power Input Requirements (customer provided)	480Y277 $\pm$ 10%, 3-phase, 50/60Hz, 5-wire (3 phase-wires plus neutral and ground). 70 A AC maximum line current per phase. (Other voltages and frequencies available on special order.)
Output (microwave)	
·a. Output power (CW)	10 KW minimum at the HeatWave output waveguide flange
b. Frequency	28 GHz nominal
c. Output connection	EIA WRC621D14 waveguide
External energy leakage	
·a. Microwave	Less than 2 milliwatts/cm <sup>2</sup> (Measured with a Narda 8712 meter and 8721D probe – or equivalent)
b. DC magnetic fields	Less than 0.5 Gauss outside the cabinet wall
c. Acoustic Noise	Less than 85 db at one meter while operating at full power (Measured with a Quest Electronics model M27 or equivalent)
d. X-ray	Less than 0.1 mr/hour (measured with a Victoreen Model 440RFD X-ray Monitor or equivalent) outside the cabinet wall
Electrical Interlocks	Two normally closed, hard wired circuits

### Environmental

Storage air temperature	+1°C to 65°C with water in the internal HeatWave cooling system. -15°C to 65°C without water in the internal HeatWave cooling system.
Operating air temperature	+10°C to 40°C
Cooling water flow/pressure	15 US Gallons per minute minimum flow rate. Pressure drop across the HeatWave cooling system is 70 Pounds per Square Inch maximum at that flow condition.
Cooling water inlet temperature	+15°C to +30°C with full RF operation.
Humidity	99% maximum (non-condensing)
Shock and Vibration	Sufficient for international shipment