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Heatwave Model VIA-301
Data Sheet

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General Description

VIA-301 Heatwave Generator

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.

CABINETRY

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.

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.

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.

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 ±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^2 (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 External Interlocks	Two normally closed, hard wired circuits are provided to the user.

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

Cooling Water Recommendations (customer provided)

Resistivity	30 KΩ-cm at 30°C minimum
pH factor	6.0 to 8.0
Particulate matter size	Not larger than 50 microns
Connections	1.5 inch female NPT

Waveguide Fill Gas Recommendations (If desired - customer provided)

Gas	Air, nitrogen, or carbon dioxide
Particulate matter size	not larger than 0.2 microns
Dew point	Less than -20°C at all times

Standard Factory Testing

The following testing is conducted at the CPI factory on each VIS-103A Heatwave unit. Additional testing is available as an option.

Standard Test Conditions

Power Input will be the standard 480Y277 Volt nominal, 60 Hz, 3 phase power (5-wire) that is commercially available at the CPI facility.

Cooling water will be at the nominal flow rate for this Heatwave unit (15 GPM). Water temperature will be within the range from +15°C to +30°C at the water inlet to the Heatwave unit under test.

Ambient air conditions will be in the range from 20°C to 35°C at the CPI facility.

The Heatwave unit under test will sit directly on the floor inside the CPI facility. It will not be on any type of shock isolation device.

Standard Tests

Name of the test	Test method	Data provided
Power Output (normal – CW)	Use the control center to adjust power output from 10% to 100% of maximum rated forward power. The gyrotron is an oscillator and the frequency is not adjustable. Test frequency is approximately 28 GHz.	Data table and a graph showing the power output actually obtained at 6 power percentages distributed from 10% to 100%
Interlocks	Test the 2 externally available interlocks for functionality	Data showing that the proper result occurred for each interlock that was tested.
Heatwave internal interlocks	Test each of the Heatwave interlocks for functionality	Data showing that the proper result occurred for each interlock that was tested.
Emergency OFF button	Exercise the Emergency OFF button.	Data recorded that shows that the correct function of the test was achieved.
RF Leakage	Use a Narda 8712 meter and 8721D probe – or equivalent to make this measurement external to the unit under test. All panels will be on the cabinet as would normally be the case when the unit is actually used.	Data showing the leakage was less than 2 milliwats/cm^2.
External DC magnetic fields	All panels will be on the cabinet as would normally be the case when the unit is actually used.	Data showing that the test result was less than 0.5 Gauss
Acoustic noise	Use a Quest Electronics model M27 or equivalent to make this measurement external to the unit under test. All panels will be on the cabinet as would normally be the case when the unit is actually used.	Data showing that the test result was less than 85 db
X-ray	Use a Victoreen Model 440RFD X-ray Monitor or equivalent external to the unit under test. All panels will be on the cabinet as would normally be the case when the unit is actually used.	Data showing that the result was less than 0.1 mr/hour