Microwave System for Laboratory Process Research

The system described below is configured for the development of microwave heating processes using small material samples having relatively low dielectric loss characteristics. General descriptions of each element in the system are provided below. All are available from GAE in various waveguide sizes, flange types and other optional configurations.

(1) **Power Supply and Controls**
Low ripple magnetron power supplies are generally preferred for laboratory process development as they provide the greatest stability and are well suited for heating low loss materials. The power supply and microwave power head (see below) must be compatible with each other and are usually provided as a set. Controls include complete local functionality as well as remote analog and digital interfaces.

(2) **Microwave Power Head**
The magnetron is often separated from the power supply for convenience and to conserve bench-top space. The maximum output power should be selected as required by the process. Cables are provided for connection to the power supply.

(3) **Circulator 1**
The magnetron must be protected from the damaging effects of reverse power. This is usually accomplished using a 3-port circulator and dummy load, often called an isolator when used together. Reverse power is diverted to and absorbed by the dummy load.

(4) **Dummy Load**
The dummy load absorbs microwave power and, when used in an isolator configuration, should be rated for the maximum expected reverse power (usually maximum forward power).

(5) **Circulator 2** (optional)
A second circulator used in conjunction with a dummy load and power reflector (see item 6 below) can function as a variable attenuator to provide a means for variable power delivery at constant frequency. This enhances operational stability under “high Q” conditions, such as often encountered when heating low dielectric loss materials. Note that Circulator 2 is installed with ports 1 and 2 inverted as compared to Circulator 1.

(6) **Dummy Load with Power Reflector** (optional)
When used with Circulator 2 (see item 5 above), this device provides the means for manually adjusting microwave power delivered to the process load while maintaining constant output frequency from the microwave generator.

(7) **Forward and Reverse Power Monitor**
The forward power monitor indicates actual delivered microwave power while the reverse power monitor indicates power reflected from the load.

(8) **Multi-Stub Tuner**
The impedance of the process load must be matched to that of the microwave source in order to achieve optimal microwave power absorption. A multi-stub tuner is most often used and is available in manual and automatic versions. Tuning progress is indicated by the reflected power monitor (see item 7 above).

(9) **Applicator**
Microwave power is coupled to the process material inside an applicator, also called a chamber or cavity. Most applicators are designed for specific materials and process methods. GAE offers a waveguide applicator designed to accommodate a variety of load and process types.

(10) **Termination**
Certain waveguide applicators require a short circuit termination to establish an internal standing wave at the material being heated. While a fixed position short circuit can be used in many cases, an adjustable short circuit is recommended for laboratory use to accommodate different load materials.

Typical Component Selection

The following is a list of standard GAE components often used in a typical laboratory process research system. All components in this configuration feature the popular tapered round waveguide flange for use with quick-disconnect clamps. Alternate components and configurations are available to accommodate specific process development requirements. Contact GAE for more detail on each component and optional configurations.

(1) **GA4104A** – 1.2kW Low Ripple Power Supply
(2) **GA4001A** – 1.2kW Magnetron Head, WR284
(3) **GA1105B** – 3-Port Circulator, WR284
(4) **GA1204** – Short Dummy Load, WR284
(5) **GA1105B** – 3-Port Circulator, WR284
(6) **GA1214** – Dummy Load with Power Reflector, WR284
(7) **GA3004** – Dual Power Monitor, WR284
(8) **GA1009** – Precision 3-Stub Tuner, WR284
(9) **GA6002** – Universal Applicator, Dual Side, WR284
GA83XX – Adapter for Univ. Applicator (2 req. – specify type)
(10) **GA1205A** – Sliding Short Circuit, WR284

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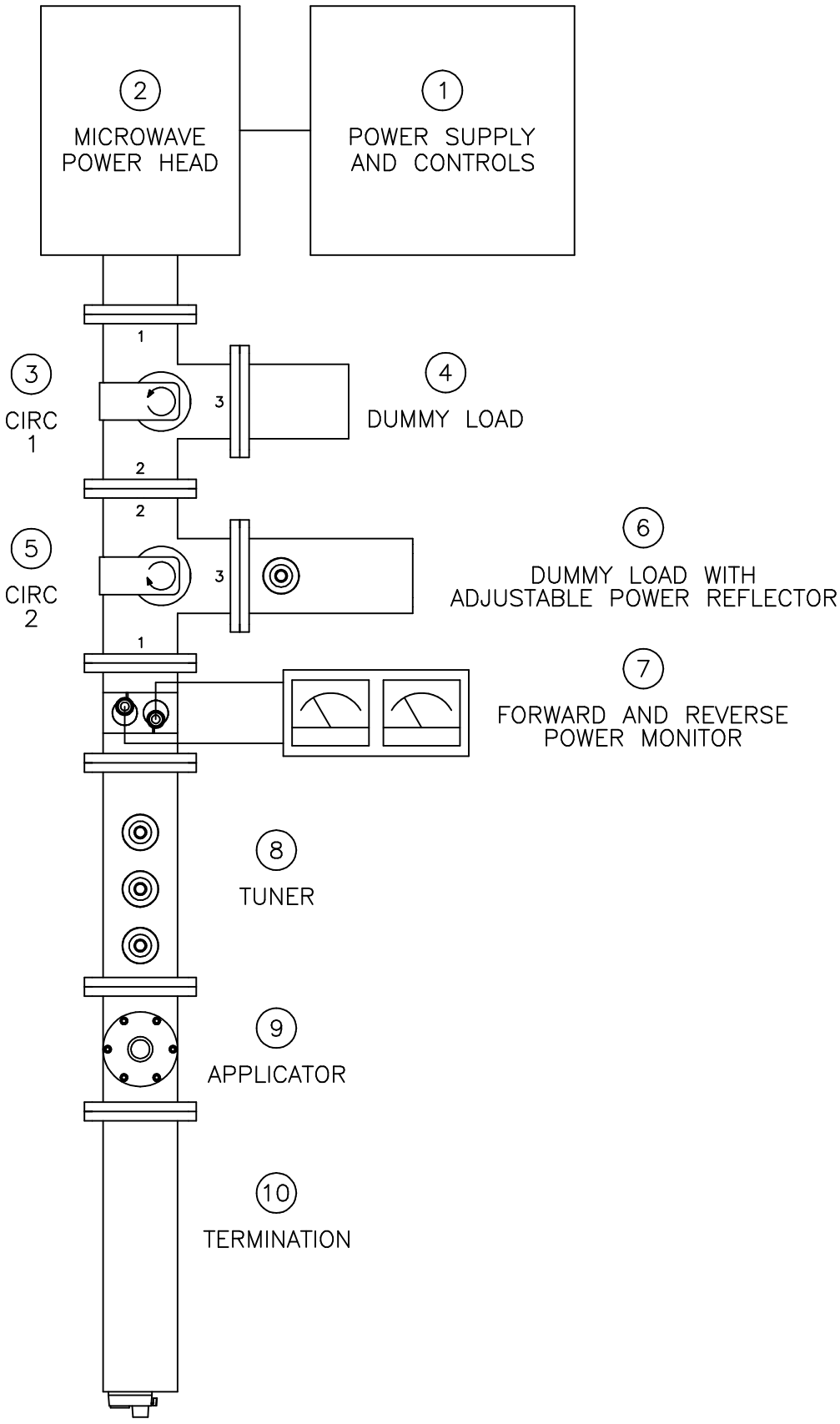

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