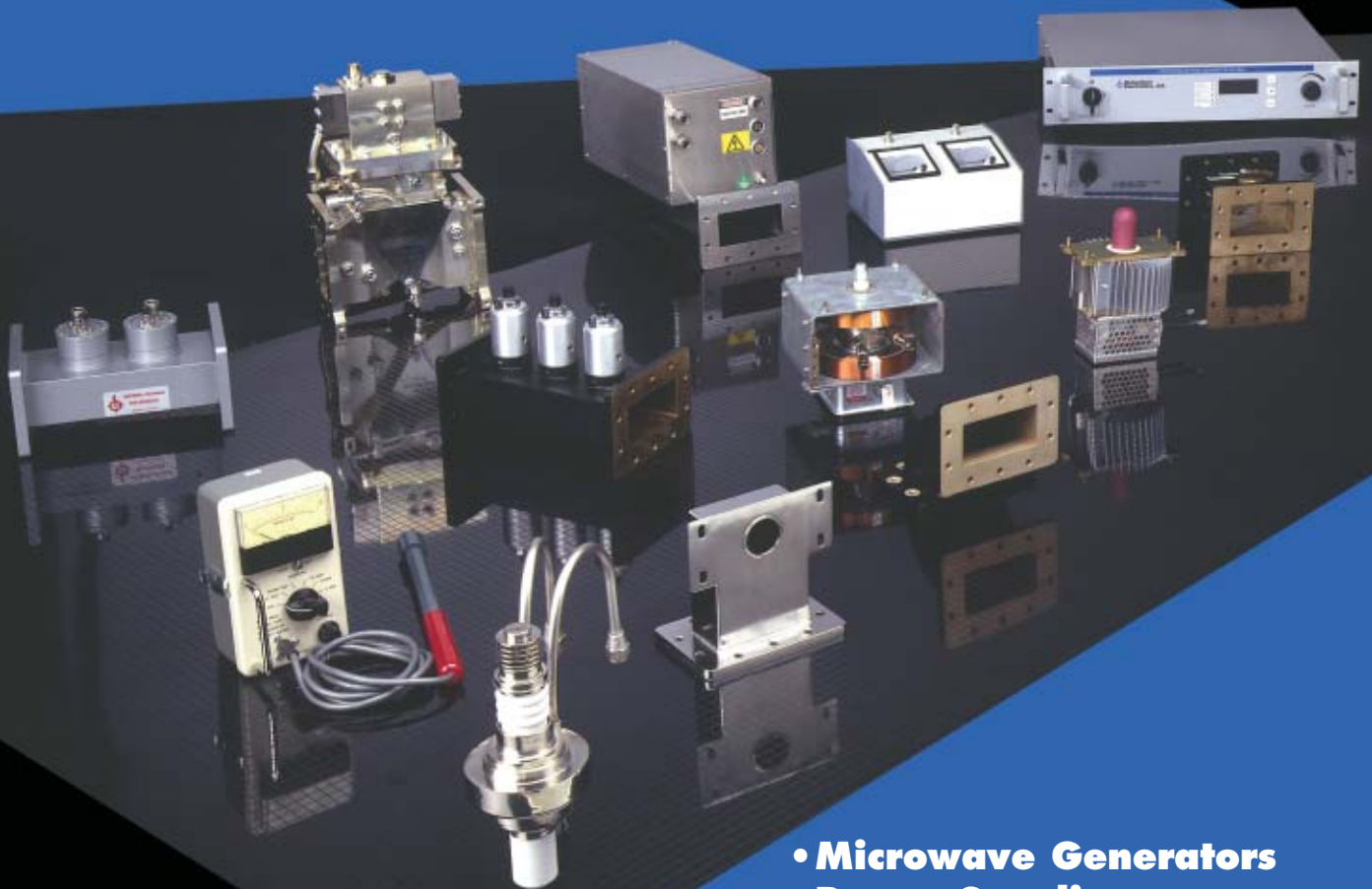


Industrial Microwave Product Guide

 **Richardson
Electronics**
Engineered Solutions



- **Microwave Generators**
- **Power Supplies**
- **CW Magnetrons**
- **Circulators & Isolators**
- **Waveguide Components**
- **Solid-State Generators**
- **Microwave Leakage Meters**
- **High Voltage Diodes, Capacitors and Transformers**

World-Class Logistic Services & Support

Richardson Electronics offers a full line of industrial microwave products. Specializing in CW magnetrons and waveguide components, including launchers, isolators, directional couplers, tuners and loads, Richardson also offers complete microwave generators as well as the individual components necessary to build your own system. We offer transformers, high voltage diodes, capacitors, arc detectors, supervisory boards and diode detectors along with many other components necessary for the original equipment manufacturer that is designing an industrial microwave system. To insure safe operation of microwave equipment we also offer leakage meters and area detectors. With our manufacturing and engineering capabilities we can also offer custom designed products.

Call Richardson Electronics today — and have the industrial microwave components you need tomorrow!

Applications Engineering Support

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Cross-Referencing

Our cross-reference library contains hundreds of thousands of part numbers accumulated over 50 years of experience. Selecting the right industry standard product for your application is as easy as calling Richardson Electronics or visiting our on-line catalog at <http://industrial.rell.com>.

Logistics Support

Through a world-class logistics support network (including 45 worldwide stocking locations), Richardson provides services designed to meet or exceed customer expectations. Some of these services include: 24 hours/7 days per week “on call” support; ship scheduling to meet JIT or future planned need dates; consolidated shipments (both to domestic or international locations); special re-packaging and/or labeling (including bar-code labels to assist your receiving department); coordination with our customers’ freight carriers; consolidated purchasing services; special product testing or acting as the 3rd party logistics provider for your company.



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Richardson Electronics' Corporate Headquarters in LaFox, Illinois.

Inventory Management Program

We will custom design our process to work for your requirement. Whatever replenishment tool you use — PC-based, bar coding, wand — can be interfaced with our system to deliver our stock to your production line efficiently and cost-effectively.

Electronic Data Interchange

Like many Fortune 500 customers utilizing our EDI capabilities, you can save time, money and eliminate paperwork. Your purchase order is transmitted to our EDI computer system which mobilizes our distribution logistics team to get the products you need out the door promptly.

Same Day Shipping Up to 6 PM (CST)

Same day shipments to domestic U.S. customers are provided when the stock order is received in the Richardson distribution center as late as 6 PM (Central Standard Time). Depend on our extensive inventory (70,000 SKUs) and efficient logistical system to get your order shipped today.

What is “Value-Added?”

Richardson Electronics believes value-added services are a total team effort of product customization, with an emphasis on quality.

“Value-added” is the process through which Richardson Electronics enhances a product or service before offering it to our customers. We utilize our unique manufacturing capabilities, technical knowledge and design-in support capabilities to meet our customers’ stringent requirements. Offering cost-effective, engineered solutions to our valued customers is our mission.

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NOTE:

All of the magnetrons and components in this catalog are designed for continuous wave (CW) use unless otherwise noted. All information is for typical operation unless noted. For more complete information and data sheets, please contact your Richardson Electronics representative.

Characteristics and operating values shown in this catalog are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. Richardson Electronics is not responsible for typographic errors.

E-Commerce

RELL Online, Richardson Electronics' catalog on the web, now offers electronic commerce capabilities. Navigate through our extensive product offering of more than 130,000 items and place an order 24 hours a day, 7 days a week.

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A guide to terms used in our catalog.

Anode

The electrode to which a principle electron stream flows by means of application of a positive voltage with respect to the cathode.

Antenna

The conductor used to couple energy from the magnetron resonant circuit to the launcher.

Applicator

That part of the microwave system used to transmit the microwave power to the product or load, typically designed for products of similar microwave properties.

Arc

Phenomenon caused by electrical breakdown between two conductors that results in the generation of visible light and high currents that may lead to damage or catastrophic failure of the magnetron.

Arc detector

An instrument used to detect waveguide arcs and provide a disabling signal to the magnetron power supply.

CW

Continuous wave.

Cathode/Filament

The electrode which is the primary source of an electron stream, typically constructed of carburized thoriated tungsten wire which is directly heated by application of filament voltage.

Circulator

A three-port waveguide component utilizing ferrite technology to selectively direct energy to a specific port based on the direction of wave propagation.

Isolator

A circulator with a dummy load attached to one port, utilized to protect the magnetron from power reflected by the product/load.

Directional coupler

A device used to couple power from the waveguide system at a reduced value to facilitate equipment interface for frequency, power and other system measurements. Dual couplers are available that can be used to couple both forward and reverse power.

Dummy load

An air or water-cooled load that dissipates the power applied with little or no reflection.

f/f_o

Frequency/center frequency.

I_a

Mean anode current.

I_{ap}

Peak anode current.

I_f

Filament/heater current.

I_m

Electromagnet current.

ISM frequency bands

Industrial, scientific and medical bands allocated (with only minor variations worldwide) for use in activities at 915 MHz (L-band) and 2450 MHz (S-band).

Launcher/launching section

A waveguide component designed for a specific magnetron that couples the microwave energy from the antenna to the waveguide system.

Magnetron

A low-cost, efficient, cross-field microwave oscillator.

Moding

Operational instability of the magnetron resulting in oscillations at other than the fundamental frequency.

Parameters that cause moding are load VSWR and phase, and power supply design with respect to current waveform and input current regulation. Moding can lead to damage or catastrophic failure of the magnetron.

P_o

Average output power.

Power supply

The system that interfaces with the magnetron input terminals to provide power for filaments and oscillation of the device. System control circuits and magnetron fault protection are typically incorporated into this unit.

Probe

Used in the design phase of a microwave system to determine the operating point of the magnetron on the Rieke diagram with respect to the load.

Rieke diagram

A circular chart describing the relationship between the output phase and VSWR of a microwave system with respect to the operating frequency and output power of the magnetron.

Sink phase

The target operating phase of the magnetron, denoted on the Rieke diagram by a convergence of the frequency contours in conjunction with high output power. In order to avoid damage to the magnetron, the microwave system should be designed for operation in the sink phase.

Tuner

A mechanical waveguide component used for matching of the load impedance to that of the magnetron, thereby reducing reflected power and maximizing coupling of power to the load/product.

V_a

Mean anode voltage.

V_{ap}

Peak anode voltage.

V_f

Filament/heater voltage.

V_m

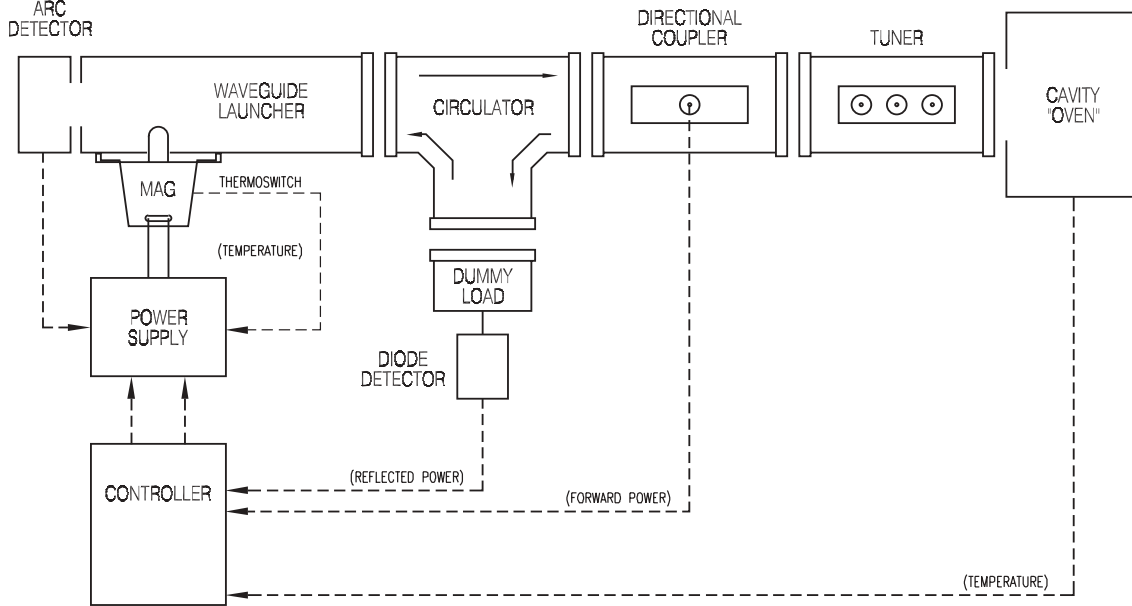
Electromagnet voltage.

VSWR

Voltage standing wave ratio.

Typical System Diagram

Richardson Electronics offers the components to help build a system similar to the one shown below.



As you begin to build your industrial microwave system, Richardson Electronics offers these helpful guidelines.

Control of Magnetron Output Power Extending Magnetron Life

The output power of a magnetron is proportional to the average operational anode current of the device. Variable output power is typically accomplished via one of the following methods of current control:

1. Control of average anode current by variation of the duty cycle

This method requires operation of the magnetron at varying duty cycles. An increase in the duty cycle results in an increase in average current and a corresponding increase in output power. This approach may be implemented at a relatively low cost. The disadvantage of duty cycle control is that the output power is not constant with time. Periods of operation at high peak power levels followed by periods of no power will result, rendering this approach unacceptable for some applications.

2. Control of peak anode current by power supply

Methods of power supply design may be employed that allow control of the peak anode current. These methods provide continuous output power. The disadvantage of this method is the cost and complexity of the power supply design.

3. Control of anode current by variation of magnetic field

Magnetrons with electromagnets provide a cost-effective way to vary the output power. Adjustment of the magnetic field strength results in a corresponding variation in anode current and thereby output power. The advantage of this method is that a continuous output power can be realized over a wide range of power levels.

Magnetrons, like all electron tubes, have a finite life and should be considered a consumable item. There are a number of factors that contribute to the life of a magnetron. Certain steps may be taken to avoid shortened life. Care should be taken in the design of the power supply to ensure the magnetron is operated within specified parameters. The various input voltage and current specifications should be followed, particularly the filament voltage, peak anode voltage, and average anode current. Where applicable, the filament reduction schedule should be followed.

Adequate cooling should be provided to the magnetron. Most magnetrons rated below 3 kW of output power only require air cooling, however water cooling is a more effective method of dissipating heat and will increase the life of the magnetron. Most magnetrons rated 3 kW and above require water cooling for adequate heat dissipation. The magnetron data sheet will specify the minimum air or water flow required for cooling the magnetron.

Even small amounts of microwave energy reflected by the load can be damaging to the magnetron. Reflected energy absorbed by the magnetron may cause overheating and arcing, leading to premature failure. Reflected power may also affect magnetron operation by changing output power or causing a frequency shift. The use of an isolator (circulator) is recommended to minimize the amount of reflected energy and protect the magnetron. Although an isolator is an added expense to the total system cost, it will reduce expensive downtime and long-term maintenance costs. An isolator will normally operate throughout the life of the system, and it has the added benefit of stabilizing the output of the magnetron for more critical applications.

2450 MHz: Low Power Microwave Heads

Alter Low Power Microwave Heads

Designed for Switching Power Supplies (Variable Output)

Max Output Power	Part Number	Freq. MHz	Cooling Type	Recommended Power Supply**	Cable Set
900 W	TMA0.9V0x	2450	Air	CM340E	Call
900 W	TM00.9V0x	2450	Water	CM340E	Call
1200 W	TMA1.2V0x	2450	Air	SM445G or CM440E	Call
1200 W	TM01.2V0x	2450	Water	SM445G or CM440E	Call
1500 W	TMA1.5V0x	2450	Air	SM745G	Call
1500 W	TM01.5V0x	2450	Water	SM745G	Call
2000 W	TMA2.0V0x	2450	Air	SM745G or SM840E	Call
2000 W	TM02.0V0x	2450	Water	SM745G or SM840E	Call
3000 W	TM03.0V0x	2450	Water	SM1050D/T* or SM1150D	Call

* D = 208V T = 400V

** See pages 13 & 14 for detailed information.



Alter Microwave Head Features

TMA = Air-cooled
TM0 = Water-cooled

Common features:

- Output power is variable from 10% of the max. rated power
- **CE compliant**
- Framework and waveguide in stainless steel
- WR340/PDR26 style flange
- Separate industrial connectors for main & signals
- TM0 overall dim. (water cooled type): 218 x 233 x 305 mm
- TMA overall dim. (air cooled type): 218 x 233 x 390 mm

Basic Version (V00) Includes:

- Magnetron
- Arc detector
- Thermoswitch
- Filament transformer
- Microswitch on cover
- Thermoswitch on magnetron
- Fan (only on air-cooled type)
- High voltage input direct (no connector)

Version 1 (V01) includes: all V00 features and:

- Water flow switch (on water cooled types)
- Air pressure switch (on air cooled types)
- Lamp (ON status)

National Low Power Microwave Heads

Designed for Switching Power Supplies (Variable Output)

Max Output Power	Part Number	Freq. MHz	Cooling Type	Recommended Power Supply**	Cable Set
1200 W	UWHEAD1.2FAC-SM	2450	Air	SM445G	CS445/UWHEAD
1200 W	MH1.2W-S	2450	Water	SM445G	MHC/445
2000 W	UWHEAD2.0FAC-SM	2450	Air	SM745G	CS745/UWHEAD
2000 W	MH2.0W-S	2450	Water	SM745G	MHC/745
2000 W	MH2.0W-S1	2450	Water	SM840E	MHC/840
3000 W	MH3.0W-S	2450	Water	SM1050D/T*	MHC/1050D/T
3000 W	MH3.0W-S1	2450	Water	SM1150D	MHC/1150

* D = 208V T = 400V

** See pages 13 & 14 for detailed information.



Richardson Microwave Head Features

Common features are:

- Output power is variable from 10% of the max. rated power
- Framework and waveguide in stainless steel
- WR340/PDR26 style flange
- Separate industrial connectors for main & signals

All versions include:

- Magnetron
- Filament transformer
- Thermoswitch on magnetron
- Arc detector
- HV Lemo connector for input
- Microswitch on cover

2450 MHz: Low Power Microwave Generators (Fixed Output)

Low Power, Complete Microwave Generators with Inductive Power Supply & Remote Magnetron Head

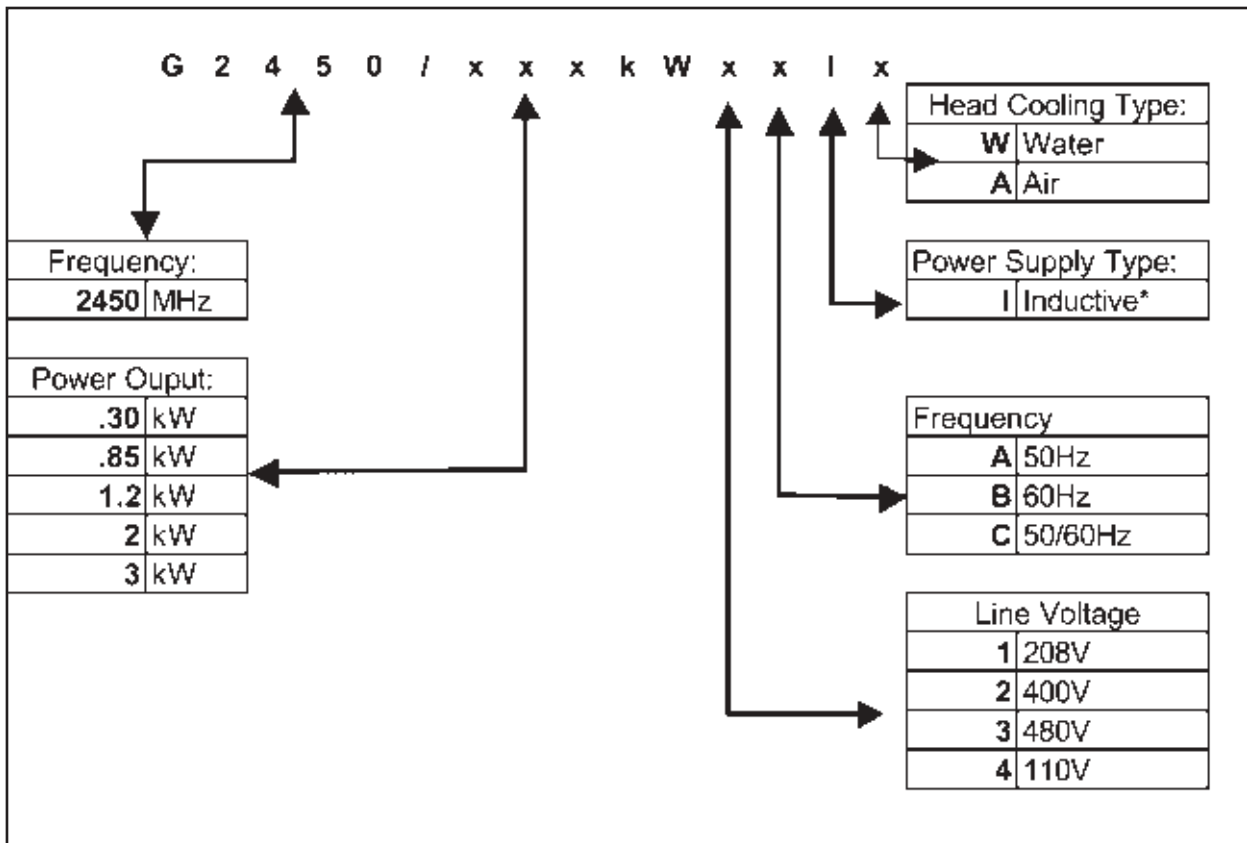
Max Output Power	Freq. MHz	Cooling Type	Magnetron Head	Power Supply	Cable Set	Part Number
300 W	2450	Air	Remote	Inductive	Included	G2450/.30kWxxIA
	2450	Water	Remote	Inductive	Included	G2450/.30kWxxIW
850 W	2450	Air	Remote	Inductive	Included	G2450/.85kWxxIA
	2450	Water	Remote	Inductive	Included	G2450/.85kWxxIW
1200 W	2450	Air	Remote	Inductive	Included	G2450/1.2kWxxIA
	2450	Water	Remote	Inductive	Included	G2450/1.2kWxxIW
2000 W	2450	Air	Remote	Inductive	Included	G2450/2.0kWxxIA
	2450	Water	Remote	Inductive	Included	G2450/2.0kWxxIW
3000 W	2450	Air	Remote	Inductive	Included	G2450/3.0kWxxIA
	2450	Water	Remote	Inductive	Included	G2450/3.0kWxxIW

Note: See previous page for switch-mode type power supply systems.

Part Numbering System

Example Part Number: **G2450/1.2kW1BIW**

2450MHz, 1200W MW Generator with remote, water-cooled magnetron head and Inductive type power supply. 208V/60Hz.



Note: See previous page for switch-mode type power supply systems.

2450 MHz: High Power Microwave Generators (Variable Output)

High Power, Complete Microwave Generators with Remote or Integrated Magnetron Head.

All of our microwave generators come standard with an isolator, RS232 interface, LCD screen and keypad control.

The following interface options are also available:

- CANbus
- ProfiBus
- Device Net
- RS485 interfacing.

Other options are available upon request. Please contact your local Richardson sales representative.



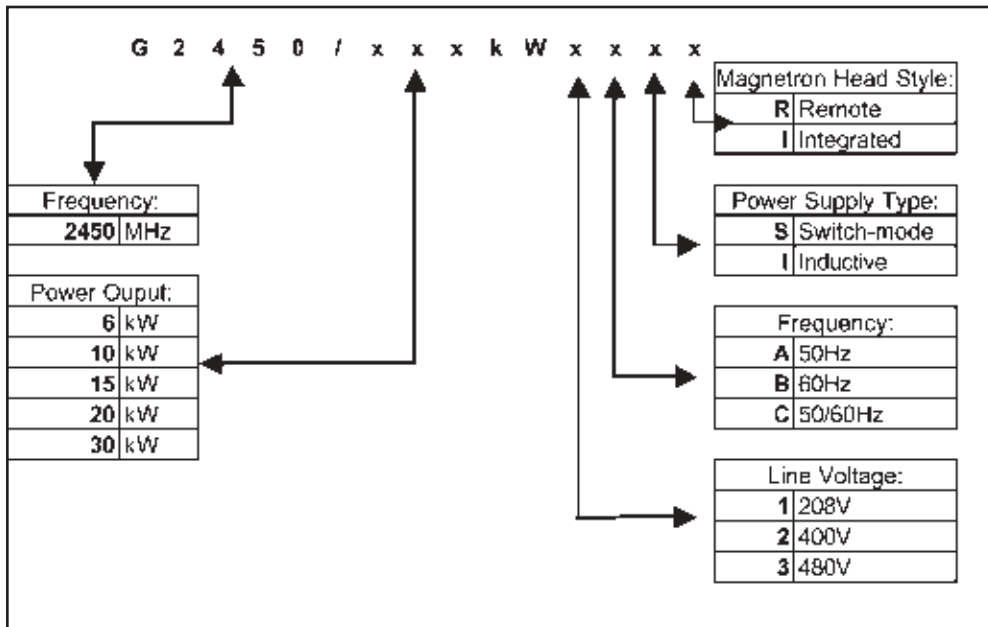
Max. Output Power	Freq. MHz	Cooling Type	Magnetron Head	Power Supply	Cable Set	Part Number
6kW	2450	Water	Remote or Integrated	Inductive*	Included	G2450/6kWxxxx
10kW	2450	Water	Remote or Integrated	Inductive or Switch-mode	Included	G2450/10kWxxxx
15kW	2450	Water	Remote or Integrated	Inductive or Switch-mode	Included	G2450/15kWxxxx
20kW	2450	Water	Remote or Integrated	Inductive or Switch-mode	Included	G2450/20kWxxxx
30kW	2450	Water	Remote or Integrated	Inductive or Switch-mode	Included	G2450/30kWxxxx

Note: See page 9 for 6kW, switch-mode type.

Part Numbering System

Example Part Number: **G2450/15kW2AII**

2450MHz, 15kW MW Generator with integrated magnetron head and inductive type power supply. 400V/50Hz.



2450 MHz: 6kW, Microwave Generators (Variable Output)

Alter 6kW

Complete microwave generator with switch-mode power supply and remote magnetron head and isolator.

Max Output Power	6kW
Freq. MHz	2450
Cooling Type	Water
Magnetron Head	Remote
Power Supply	SM1180
Cable Set	Included
Input Voltage	400V
Part Number	GEN6KW400Vxx



The GEN6KW400Vxx¹ is a 6kW, 2.45GHz microwave generator system consisting of a generator head, power supply, and isolator. The TM060 generator head is packaged in a stainless steel cabinet and houses a water-cooled YJ1600 magnetron, launching section, filament transformer, arc detector, and a reflected power measurement device. The power supply is the SM1180 switch-mode, low ripple supply featuring constant current control. The SM1180 is operated by a CPU and uses a front panel interface to control and display the functions of the power supply and microwave generator head. A 6.5kW isolator is supplied with the generator system to protect the magnetron from reflected energy. The optional reverse power measurement device is connected to a monitoring port on the isolator's water-load. Reflected power information is relayed to the SM1180's control unit and displayed on the interface. The system has been designed so that the microwave generator can be remotely installed with respect to the power supply. This separation allows for greater system flexibility and simplifies both installation and maintenance. This system is **CE compliant**.

¹ Various options for the generator system are available on request. Please contact your local Richardson Electronics specialist for further information.

National 6kW

Complete microwave generator with switch-mode power supply, remote magnetron head and isolator.

Max Output Power	6kW
Freq. MHz	2450
Cooling Type	Water
Magnetron Head	Remote
Power Supply	MG10 series
Cable Set	Included
Input Voltage	208V / 480V
Part Number	GEN6KW208 / GEN6KW480



The GEN6KW208/480 is a 6kW, 2.45GHz microwave generator system consisting of a generator head, power supply, and isolator. The generator head is packaged in a stainless steel cabinet and houses a water-cooled YJ1600 magnetron, launching section, filament transformer, and arc detection circuitry. The power supply is a Spellman MG10 series switch-mode, low ripple supply featuring constant current control. A 25-pin, D-sub connector on the back of the supply provides a user interface to control the system. A 6.5kW isolator is supplied with the generator assembly to protect the magnetron from reflected energy. An N-type monitoring port on the water-load provides an RF measurement of reflected energy. The GEN6KWCONTROLA/B is an optional control unit that interfaces with the power supply to control the generators output power. Two front panel potentiometers are provided to adjust the magnetrons anode voltage and anode current, which are displayed on two front panel meters.

2450 MHz: Component Sets



Component Sets

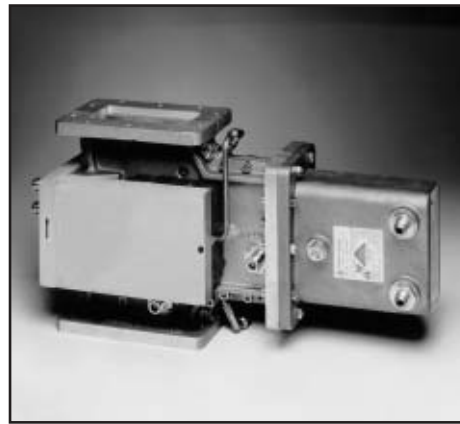
A multitude of ancillary components are used to transmit, measure and alter the microwave energy generated from a magnetron. These component sets usually include a magnetron, waveguide launcher, circulator, water-load and a power supply.

5 & 6kW, 2450MHz Component Sets

Description	5kW	6kW
CW Magnetron	H3891	YJ1600
Waveguide Launcher	WR340LAUN-1600C*	WR340LAUN-1600C*
Isolator	2722-162-10311	2722-162-10311
Arc Detector	MON00020	MON00020
Power Supply**	MG10PS (208 or 480V) or SM1180T (400V)	MG10PS (208 or 480V) or SM1180T (400V)

*Includes mounting cylinder for integral arc detector. (Arc detector not included).

** See pages 14 & 15 for detailed information.



8-30kW, 2450MHz Component Sets

Description	8kW	15kW	20kW	30kW
CW Magnetron	NL10245	NL15245	NL20245	NL30245
Waveguide Launcher	NL15245ASSY-A*	NL15245ASSY-A*	NL20245L	NL30245L
Electromagnet	NL15245ASSY-A*	NL15245ASSY-A*	NL20245M	NL30245M
Pole Pieces	NL15245ASSY-A*	NL15245ASSY-A*	NL20245POLE	NL30245POLE
Connector Set	NL10245-CONN	NL15245-CONN	NL20245-CONN	NL30245-FILCON & NL30245-CATCON
3-Port Circulator	2450.201.803.02	2450.201.803.02	2450.201.803.02	2450.201.124.00
Dummy Water Load	2450.203.203.01	2450.203.203.01	2450.203.203.01	2450.203.303.00
Power Supply**	MG12PS (208/480V)	MG24PS (415/480V)	MG24PS480 (415/480V)	MG48PS480 (415/480V)

* Includes electromagnet, launcher and upper & lower pole pieces.

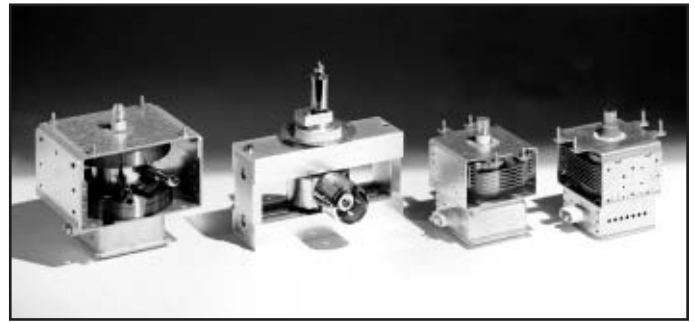
** See page 15 for detailed information.

2450 MHz: Magnetrons

100W - 3kW, 2450 MHz CW Magnetrons

Magnetron: A low-cost, efficient cross-field microwave oscillator used for the generation of continuous-wave (CW) energy.

Below is a partial listing of magnetrons we offer from stock. We also offer custom design, testing and cross-referencing.



Part Number	Freq. (MHz)	Output Power (kW)	V _f (V)	I _f (A)	V _{ap} (kV)	I _a (mA)	I _{ap} (mA)	Cooling	Mounting Configuration**
NL10230-1A*	2450	3.00	4.6	16	5.4	900	2650	water	NIL (J)
NL10230-5*	2450	3.00	4	23	5	900	2100	air	IL (H)
2M251-05	2450	3.00	4	23	5	900	2100	air	IL (H)
2M252-05	2450	3.00	4	23	5	900	2100	water	NIL (J)
YJ1442-C	2450	3.00	5	20	6	800	1100	water	—
YJ1442E	2450	3.00	5	20	6	800	1100	water	—
DX582	2450	2.70	4.6	19	5	900	1100	water	IL (H)
NL10250-1*	2450	1.90	4.6	19	4	725	2100	air	IL (H)
NL10250-2*	2450	1.90	4.6	19	4	725	2100	air	NIL (J)
2M130-11/IL	2450	1.90	4.6	19	4	725	2100	air	IL (H)
2M130-06/NIL	2450	1.90	4.6	19	4	725	2100	air	NIL (J)
NL10250-3A*	2450	1.90	4.6	19	4	725	2100	water	—
NL10251-2*	2450	1.60	4.6	19	3.6	700	1800	air	IL (H)
2M131-04A	2450	1.60	4.6	19	3.6	700	1800	air	IL (H)
NL10254-IL*	2450	1.45	4.6	14	4.5	450	1800	air	IL (H)
NL10254-1*	2450	1.45	4.6	14	4.5	450	1800	air	NIL (J)
2M121A-53	2450	1.45	4.6	14	4.5	450	1800	air	IL (H)
2M121A-57	2450	1.45	4.6	14	4.5	450	1800	air	NIL (J)
NL10259-1*	2450	1.45	4.6	14	4.5	450	1800	air	IL (H)
2M120-21	2450	1.45	4.6	14	4.5	450	1800	air	IL (H)
NL10259-2*	2450	1.45	4.6	14	4.5	450	1800	air	NIL (J)
2M120-27	2450	1.45	4.6	14	4.5	450	1800	air	NIL (J)
NL10259-3*	2450	1.45	4.6	14	4.5	450	1800	water	IL (H)
NL10259-6*	2450	1.45	4.6	14	4.5	450	1800	water	NIL (J)
YJ1540*	2450	1.26	4.4	14	4.5	400	1600	air	IL (H)
2M137(IL)	2450	1.26	4.4	14	4.5	400	1600	air	IL (H)
YJ1540-1*	2450	1.26	4.4	14	4.5	400	1600	water	IL (H)
NL10305-3	2450	1.08	4.3	13.5	4.35	350	1400	air	NIL (J)
NL10305-2	2450	1.08	4.3	13.5	4.35	350	1400	air	IL (H)
2M247J	2450	1.08	4.3	13.5	4.35	350	1400	air	NIL (J)
2M247H	2450	1.08	4.3	13.5	4.35	350	1400	air	IL (H)
2M107A-605*	2450	0.88	3.3	10.5	4.1	300	1200	air	IL/NIL (K)
2M107A-795*	2450	0.88	3.3	10.5	4.1	300	1200	air	IL (H)
2M107A-825*	2450	0.88	3.3	10.5	4.1	300	1200	air	NIL (J)
YJ1511SP	2450	0.31	3.4	11.5	3	150	900	air	IL/NIL (K)
YJ1530SP*	2450	.010-.310	3.4	11.5	3	150	900	air	IL/NIL (K)

* Recommended for new designs.

** See the bottom of page 12 for mounting configuration definitions.

2450 MHz: Magnetrons

High & Low Frequency, 2450MHz CW Magnetrons

Part Number	Freq. (MHz)	Output						Cooling
		Power (kW)	V _f (V)	I _f (A)	V _{ap} (kV)	I _a (mA)	I _{ap} (mA)	
NL10250-20	Low	2.00	4.7	20	3.6	725	1800	Water
NL10250-54	Low	1.95	4.7	20	4.3	725	2100	Air
NL10250-64	High	1.95	4.7	20	4.3	725	2100	Air
NL10251-9	High	1.70	4.6	20	3.6	725	1800	Air
NL10251-10	Low	1.70	4.6	20	3.6	725	1800	Air
NL10251-3LOW	Low	1.70	4.6	20	3.6	725	1800	Water
NL10251-3HIGH	High	1.70	4.6	20	3.6	725	1800	Water
NL10251-4LOW	Low	1.70	4.6	20	3.6	725	1800	Water

5kw - 6kW, 2450MHz CW Magnetrons

Part Number	Frequency (MHz)	Output Power (kW)	V _f (V)	I _f (A)	V _{ap} (kV)	I _a (mA)	I _{ap} (mA)	Magnet
YJ1600*	2450	0.6-6	5	33	7.2	1150	1300	PM ² /EM ¹
YJ1191A	2450	6	5.5	44	7.3	1250	1500	PM ²
YJ1193	2450	6	5.5	44	7.3	1250	1500	PM ²
YJ1193E	2450	1-6	5.5	44	7.3	1250	1500	EM ¹
H3881*	2450	6	5	29	7.3	1100	2100	PM ²
H3891*	2450	5	5	23.5	7.3	920	2100	PM ²
2M13	2450	5	6	56	7	1100	1300	EM ¹
2M68	2450	5.3	5	46	7	1100	1300	EM ¹

* Recommended for new designs

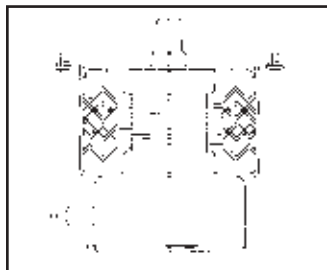
¹ Electromagnet

² Permanent Magnet

10-30kW, 2450MHz CW Magnetrons

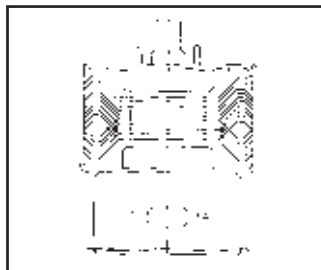
Part Number	Frequency (MHz)	Output Power (kW)	V _f (V)	I _f (A)	V _{ap} (kV)	I _a (mA)	I _m (A)
NL10245	2450 ±30	1.0-10.0	10	36	10	1600	3.2
NL15245	2450 ±30	1.5-15.0	10	47	12	1800	3.6
NL20245	2450 ±30	1.5-20.0	10	50	14.5	2100	4.9
NL30245	2450 ±20	1.5-30.0	6.4	66	13.5	3300	6

Mounting Configurations



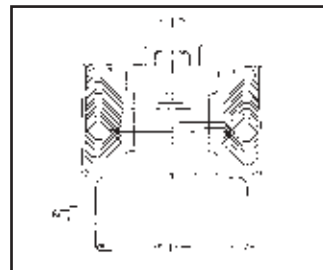
IL/NIL (K)

Mounting is in-line (IL) with connector. Airflow is not-in-line (NIL) with connector.



IL (H)

Mounting and airflow are in-line (IL) with connector.



NIL (J)

Mounting and airflow are not-in-line (NIL) with connector.



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2450 MHz: Switch-mode Power Supplies

CM340 (1.0kW)

The CM340 switch-mode power supply is able to supply, from remote location, the current necessary for a 1 kW magnetron, such as the 2M167 or equivalent, observing the specifications set by the electron tube manufacturer.

The unit is housed in a very compact stainless steel cabinet, suitable to be installed into a closed cabinet. The output power can be adjusted by a 0-10V analog signal. In addition to powering magnetrons, the CM 340 generator also supplies power to magnetron cooling fans, monitors magnetron temperature, carries out a number of monitoring processes independently, cuts off the power in case of malfunction and displays the alarms by means of LED. This unit is **CE compliant**.

Note: CAN-bus option available.

CM440 (1.25kW)

The CM440 switch-mode power supply is able to supply, from remote location, the current necessary for a 1.25 kW magnetron, such as the YJ1540 or equivalent, observing the specifications set by the electron tube manufacturer.

The unit is housed in a very compact stainless steel cabinet, suitable to be installed into a closed cabinet. The output power can be adjusted by a 0-10V analog signal. In addition to powering magnetrons, the CM 440 generator also supplies power to magnetron cooling fans, it monitors magnetron temperature, carries out a number of monitoring processes independently, cuts off the power in case of malfunction and displays the alarms by means of LED. This unit is **CE compliant**.

Note: CAN-bus option available.



SM445G (1.25kW)

The SM445F switch-mode power supply is capable of providing the required voltage and current to operate the 1250-watt YJ1540 magnetron or equivalent.

The power supply is designed for installation in a standard 19" rack mount cabinet and is connected to the magnetron/microwave generator with a standard 3-meter cable assembly. In addition to operating the magnetron, the SM445 power supply provides power for a cooling fan, and monitors the operating conditions of both the magnetron and the power supply. The output power can be adjusted on a continuous scale using a front panel potentiometer or through an external analog signal. Various options are available. This unit is **CE compliant**.

SM745G (2.0kW)

The SM745F switch-mode power supply is capable of providing the required voltage and current to operate the 2000-watt NL10250 magnetron or equivalent.

The power supply is designed for installation in a standard 19" rack mount cabinet and is connected to the magnetron/microwave generator with a standard 3-meter cable assembly. In addition to operating the magnetron, the SM745 power supply provides power for a cooling fan, and monitors the operating conditions of both the magnetron and the power supply. The output power can be adjusted on a continuous scale using a front panel potentiometer or through an external analog signal. Various options are available. This unit is **CE compliant**.



2450 MHz: Switch-mode Power Supplies

SM840E (2.0kW)

The SM840E switch-mode power supply is capable of providing the required voltage and current to operate the 2000 watt NL10250 magnetron or equivalent.

The unit is controlled by an on-board CPU and can be connected to a standard PC through an RS232 port. The user interface is a 4-character display with an optical encoder for adjusting the power supply's settings. The SM840E is designed for installation in a standard 19" rack cabinet and is connected to the magnetron/microwave generator with a standard 3-meter cable assembly.

In addition to operating the magnetron, the SM840E provides power for a cooling fan, and monitors the operating condition of both the magnetron and power supply. The output power can be adjusted on a continuous scale using the front panel interface or through an analog signal. This unit is **CE compliant**.

Note: CAN-bus option available.



SM1050D/T (3.0kW)*

The SM1050D/T switch-mode power supply is capable of providing the required voltage and current to operate the 3000-watt NL10230 magnetron or equivalent.

The power supply is designed for installation in a standard 19" rack mount cabinet and is connected to the magnetron/microwave generator with a standard 3-meter cable assembly. In addition to operating the magnetron, the SM1050 power supply provides power for a cooling fan, and monitors the operating conditions of both the magnetron and the power supply. The output power can be adjusted on a continuous scale using a front panel potentiometer or through an external analog signal. Various options are available. This unit is **CE compliant**. * $D=208V/T=400V$



SM1150D/T (3.0kW)*

The SM1150 switch-mode power supply is capable of providing the required voltage and current to operate the 3000 watt NL10230 magnetron or equivalent.

The unit is controlled by an on-board CPU and can be connected to a standard PC through an RS232 port. The user interface is a 4-character display with an optical encoder for adjusting the power supply's settings.

The SM1150 is designed for installation in a standard 19" rack cabinet and is connected to the magnetron/microwave generator with a standard 3-meter cable assembly. In addition to operating the magnetron, the SM1150 provides power for a cooling fan, and monitors the operating condition of both the magnetron and power supply. The output power can be adjusted on a continuous scale using the front panel interface or through an analog signal. This unit is **CE compliant**.

*Note: CAN-bus option available. * $D=208V/T=400V$*



SM1180T* (6.0kW)

The SM1180 switch-mode power supply is designed to operate the 6kW, YJ1600 magnetron. The power supply may also be used to power the TM060 microwave generator head in the GEN6KW400V00 microwave generator system. The unit is **CE compliant** and is built in a self-ventilated 19" wide rack, 7HE high, and is controlled by a front panel interface containing:

- A 4-digit display (upper) indicating forward power, anode current or voltage, and alarm codes.
- A 4-digit display (lower) indicating the reverse power (if the necessary external accessories are provided).
- Keypad interface for controlling the SM1180's CPU status LEDs

** 400V - The output power can be adjusted using the front panel interface or by an external analog signal connected to the power supply. The compact size of the SM1180 allows greater system flexibility and simplifies both the installation and maintenance.*



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2450 MHz: Switch-mode Power Supplies

6-8.5kW

MG10PS* & MG12PS**

The MG10PS and MG12PS magnetron power supplies each comprise a single power module, measuring 10 1/2" x 19" x 19". They are designed to power CW magnetrons with RF output powers of 6kW and 8.5kW respectively. The units also contain the filament supply and the interface circuits between the user's system and the power supply.

The high voltage output of the module is applied to the cathode of the magnetron, and the magnetron output power is controlled by the anode current. A magnet supply is available for magnetrons which do not have a permanent magnet. At turn on, the filament current is first applied for the pre-heat period, followed by the anode voltage and current ramps. A provision is made in the control unit to allow local control of the output voltage and current. Filament current foldback is automatically adjusted according to the value of the anode current.

Note: *208V (CE compliant) or 480V **400V or 480V



15-20kW

MG24PS415/480

Both the MG24 series (MG24PS415 and MG24PS480) magnetron power supplies are comprised of multiple 12kW power modules, each measuring 10 1/2" x 19" x 19" to drive 15-20kW magnetrons. The units also contain the filament and magnet power supplies and the interface circuits between the user's system and the power supply.

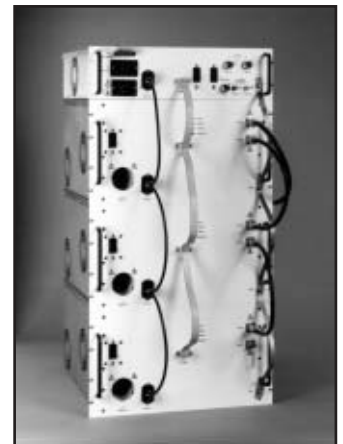
The high voltage outputs of the modules are connected in parallel and applied to the cathode of the magnetron. At turn on, the filament and magnet currents are first applied for the pre-heat period, followed by the anode voltage and current ramps. A provision is made to allow local control of the output voltage and local or remote control of the output current. RF output power is controlled by the anode current. The filament current foldback is automatically adjusted according to the value of the output current.

30kW

MG48PS415/480

Both the MG48 series (MG48PS415 and MG48PS480) magnetron power supplies are comprised of four 12kW power modules, each measuring 10 1/2" x 19" x 19" to drive a 30kW magnetron. The units also contain the filament and magnet power supplies and the interface circuits between the user's system and the power supply.

The high voltage outputs of the modules are connected in parallel and applied to the cathode of the magnetron. At turn on, the filament and magnet currents are first applied for the pre-heat period, followed by the anode voltage and current ramps. A provision is made to allow local control of the output voltage and local or remote control of the output current. RF output power is controlled by the anode current. The filament current foldback is automatically adjusted according to the value of the output current.



2450 MHz: Pulse & Inductive Power Supplies

PM740T

The PM740T pulsing power supply is suitable to drive a 2kW magnetron, such as the 2M130 or similar. It has the capability to work as a continuous or as a pulsed power supply. In continuous mode, the PM740T works as a controlled, DC source for the magnetron with a max power of 2kW. In pulsed mode, the PM740T is able to supply the pre-set mean current at a given frequency with an adjustable duty factor: the maximum peak power is near 8kW. It is controlled by a powerful microprocessor, which allows setting and adjusting of all parameters (output current, pulse frequency, duty factor, etc.). The user interface is a graphic display, LED backlit, with an optical encoder. The encoder acts as the adjustable device (similar to a potentiometer). The display provides status and set point information, alarm codes, as well as output power values. The unit has an internal pulse generator to provide the pulsing capability. This unit is **CE compliant**.



1.5kW - 3.0 kW

- GEN1.5KWPS50/60
- GEN2.0KWPS50/60
- GEN3.0KWPS50/60

The inductive power supply refers to a series of custom high voltage power supplies designed to provide power to remotely located magnetrons. These supplies are available in 300W, 1.5kW, 2kW, & 3kW versions, 50Hz or 60Hz.

The basic model of the conventional series drives a remote magnetron at a single fixed output power level. It includes circuitry that reduces in-rush current upon starting and a time delay for magnetron filament warm up to avoid cold-starting. Connections are provided for an external interlock chain and auxiliary power to a remote location, such as a magnetron head. Installation of the basic model requires only the connection of input & output power, control signals and adjustment of the filament voltage. No other user adjustments or calibrations are required.



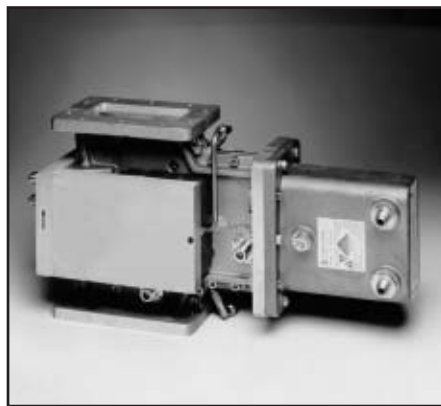
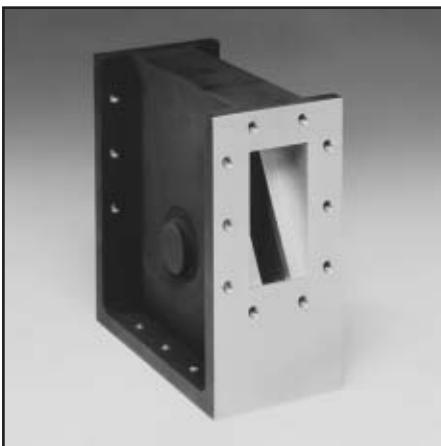
2450 MHz: Waveguide Components

Isolators & Circulators

A circulator is a passive, non-reciprocal device with three or more ports used to transmit microwave energy in a specific direction. Additionally, circulators are used to prevent reflected microwave energy from the load, thus preventing excessive magnetron heating or moding. An isolator is a circulator with a water or dry load attached to a port and is used to absorb the reflected energy.

Part Number	Frequency (MHz)	Rated Forward Power (kW)	Rated Reflected Power (kW)	Isolation (dB)	Waveguide Size	Cooling	Description
2450.201.124.00*	2450+/-10	30	30	>20	WR430	Water	Circulator
2450.201.873.00*	2450+/-10	30	15	>20	WR430	Water	Circulator
2450.201.803.02*	2450+/-10	20	20	>20	WR430	Water	Circulator
2722-162-10311*	2450+/-10	6.5	6.5	>20	WR340	Water	Isolator, input in-line with output.
2722-162-10461	2450+/-10	6.5	6.5	>20	WR340	Water	Isolator, input 90° from output.
2722-162-10471	2450+/-10	3	3	>20	WR340	Water	Isolator, input in-line with output.
2722-162-11171*	2450+/-10	3	3	>20	WR340	Water	Isolator, input in-line with output.
2722-163-02104	2450+/-10	3	3	>20	WR340	Water	Isolator, input 90° from output.
2722-162-11161*	2450+/-10	3	3	>20	WR284	Water	Isolator, input in-line with output.
2722-162-11101*	2450+/-10	3	3	>20	WR284	Water	Isolator, input 90° from output.
WR284CIRC6A	2450+/-10	6	6	>20	WR284	Water	Circulator
WR284CIRC3A	2450+/-10	3	3	>20	WR284	Air	Circulator
2722-162-10921*	2450+/-10	3	3	>20	WR284	Air	Circulator

* Recommended for new designs.



2450 MHz: Waveguide Components

Water-loads

A water-load is used to absorb microwave energy from a system. It is often used as a test load for generators and as the terminating load in an isolator.

Part Number	Power Max.	Frequency (MHz)	Flange Type
2450.203.303.00	30 kW	2450	WR430
2450.203.203.01	20 kW	2450	WR430
2722-162-10511	6.5 kW	2450	WR340
WR284LOAD6A	6.0 kW	2450	WR284



Tuners*

Tuners are waveguide components used to match the load impedance. Tuners minimize the amount of reflected power, which results in the most efficient coupling of power to the load.

Part Number	Frequency Power (kW)	Maximum VSWR	Size	Waveguide
WR430TUNER3A	2450+/-25	30.0	3:1	WR430
WR340TUNERA	2450+/-25	6.0	3:1	WR340
WR284TUNER3A	2450+/-25	6.0	3:1	WR284



* 4 Stub tuners available upon request

Auto-tuners

Auto-tuners utilize motorized tuning stubs electronically controlled by a microprocessor to match the load impedance with the source impedance. The auto-tuner minimizes the amount of reflected power, which results in the most efficient coupling of power to the load. Auto-tuners are generally used in applications where the load impedance varies significantly due to variations in the load.



Part Number	Frequency (MHz)	Max. Power (kW)	Waveguide Size	Description
WR430AUTOTUNE3A/B*	2450+/-25	up to 30kW	WR430	3-Stub Tuner Automatic Tuner. Reacts to the amount (amplitude) of reflected power.
WR430ECOTUNE3A	2450+/-25	up to 30kW	WR430	3-Stub Tuner Automatic Tuner. Reacts to the amplitude and phase of the reflected power.
WR340AUTOTUNE3A/B*	2450+/-25	6.0kW	WR340	3-Stub Tuner Automatic Tuner. Reacts to the amount (amplitude) of reflected power.
WR340ECOTUNE3A	2450+/-25	6.0kW	WR340	3-Stub Tuner Automatic Tuner. Reacts to the amplitude and phase of the reflected power.
WR284AUTOTUNE3A/B*	2450+/-25	6.0kW	WR284	3-Stub Tuner Automatic Tuner. Reacts to the amount (amplitude) of reflected power.
WR284ECOTUNE3A	2450+/-25	6.0kW	WR284	3-Stub Tuner Automatic Tuner. Reacts to the amplitude and phase of the reflected power.

* A = 19" Rack Mount Controller

B = Panel Mount Controller

Note: Electrical Tuners in WR430, 340 & 284 are also available.



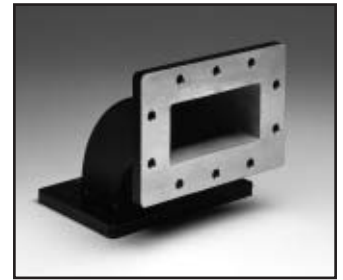
2450 MHz: Waveguide Components

Bends

Bends are used to change the direction of the waveguide transmission system.

Part Number	Material	Waveguide Size	Description
WR430EBBSB	Brass	WR430	E-Plane sweep bend
WR430EBBSA	Aluminum		E-Plane sweep bend
WR430HBBSB	Brass		H-Plane sweep bend
WR430HBBSA	Aluminum		H-Plane sweep bend
WR340EBBSB	Brass	WR340	E-Plane sweep bend
WR340EBBSA	Aluminum		E-Plane sweep bend
WR340HBBSB	Brass		H-Plane sweep bend
WR340HBBSA	Aluminum		H-Plane sweep bend
WR284EBBSB	Brass	WR284	E-Plane sweep bend
WR284EBBSA	Aluminum		E-Plane sweep bend
WR284HBBSB	Brass		H-Plane sweep bend
WR284HBBSA	Aluminum		H-Plane sweep bend

Note: 45° and mitered bends are also available upon request.



Waveguide Transitions

Waveguide transitions are used to connect waveguides of different sizes.

Part Number	Material	Description
WR340/284TRANSA	Aluminum	WR340 to WR284 waveguide transition
WR430/284TRANSA	Aluminum	WR430 to WR284 waveguide transition
WR430/340TRANSA	Aluminum	WR430 to WR340 waveguide transition



Coax Transitions

Coaxial transitions are waveguide components used to convert standard waveguide to a specific coaxial connector.

Part Number	Max. Power (kW)	VSWR	Waveguide Size	Description
WR430/COAXTRANS	0.3	<1.15	WR430	Waveguide to N-type connector
WR430/COAX7/16	1.2	<1.15	WR430	Waveguide to 7/16" connector
WR430/COAX7/8	2.0	<1.15	WR430	Waveguide to 7/8" connector
WR430/COAX1-5/8	5.0	<1.15	WR430	Waveguide to 1 5/8" connector
WR340/COAXTRANS	0.3	<1.15	WR340	Waveguide to N-Type connector
WR340/COAX7/16	1.2	<1.15	WR340	Waveguide to 7/16" connector
WR340/COAX7/8	2.0	<1.15	WR340	Waveguide to 7/8" connector
WR340/COAX1-5/8	5.0	<1.15	WR340	Waveguide to 1 5/8" connector
WR284/COAXTRANS	0.3	<1.15	WR284	Waveguide to N-type connector
WR284/COAX7/16	1.2	<1.15	WR284	Waveguide to 7/16" connector
WR284/COAX7/8	2.0	<1.15	WR284	Waveguide to 7/8" connector
WR284/COAX1-5/8	5.0	<1.15	WR284	Waveguide to 1 5/8" connector



2450 MHz: Waveguide Components

Couplers

Directional couplers are waveguide components used to measure forward and/or reflected microwave energy.



Waveguide Size WR430

Frequency (MHz): 2450+/-25

Directivity (dB): >20

Part Number	Coupling Factor (dB)	Description
WR430SDCN*	60	Single directional coupler with a female N-type connector.
WR430DDCN*	60	Dual directional coupler with female N-type connectors
WR430DDCA	NA	Dual directional coupler with BNC output detector diodes.
WR430DDCB	NA	Dual directional coupler, includes galvanometers for reading forward & reflected power.

Waveguide Size WR340

Frequency (MHz): 2450+/-25

Directivity (dB): >20

Part Number	Coupling Factor (dB)	Description
WR340SDCN*	60	Single directional coupler with a female N-type connector.
WR340DDCN*	60	Dual directional coupler with female N-type connectors
WR340DDCA1.5	NA	Dual directional coupler with BNC output detector diodes. (Calibrated to 1.5kW)
WR340DDCA2.0	NA	Dual directional coupler with BNC output detector diodes. (Calibrated to 2.0kW)
WR340DDCA3.0	NA	Dual directional coupler with BNC output detector diodes. (Calibrated to 3.0kW)
WR340DDCA6.0	NA	Dual directional coupler with BNC output detector diodes. (Calibrated to 3.0kW)
WR340DDCB1.2	NA	Dual directional coupler, includes galvanometers for reading forward & reflected power. (Calibrated to 1.2kW)
WR340DDCB1.5	NA	Dual directional coupler, includes galvanometers for reading forward & reflected power. (Calibrated to 1.5kW)
WR340DDCB2.0	NA	Dual directional coupler, includes galvanometers for reading forward & reflected power. (Calibrated to 2.0kW)
WR340DDCB3.0	NA	Dual directional coupler, includes galvanometers for reading forward & reflected power. (Calibrated to 3.0kW)
WR340DDCB6.0	NA	Dual directional coupler, includes galvanometers for reading forward & reflected power. (Calibrated to 6.0kW)

Waveguide Size WR284

Frequency (MHz): 2450+/-25

Directivity (dB): >20

Part Number	Coupling Factor (dB)	Description
WR284SDCN*	60	Single directional coupler with a female N-type connector.
WR284DDCN*	60	Dual directional coupler with female N-type connectors
WR284DDCA	NA	Dual directional coupler with BNC output detector diodes.
WR284DDCB	NA	Dual directional coupler, includes galvanometers for reading forward & reflected power.

* Additional coupling factors available upon request (e.g. 30 dB, 50 dB and 60 dB).



2450 MHz: Waveguide Components

Straight Sections

Straight waveguide is supplied either as a raw cut waveguide section or with the attached flanges. The length of a straight waveguide piece is measured from face to face of the flanges. We also offer painting and special plating (e.g. irridite) options. Please contact us for a quote.



Part Number	Material	Waveguide Size	Description
WR430WGXXXXC	Copper	WR430	Waveguide straight section (no flanges)
WR430WGXXXXA	Aluminum		Waveguide straight section (no flanges)
WR430WGXXXXCY	Copper		Waveguide straight section with flanges on either end.
WR430WGXXXXAY	Aluminum		Waveguide straight section with flanges on either end.
WR340WGXXXXC	Copper	WR340	Waveguide straight section (no flanges)
WR340WGXXXXA	Aluminum		Waveguide straight section (no flanges)
WR340WGXXXXCY	Copper		Waveguide straight section with flanges on either end.
WR340WGXXXXAY	Aluminum		Waveguide straight section with flanges on either end.
WR284WGXXXXC	Copper	WR284	Waveguide straight section (no flanges)
WR284WGXXXXA	Aluminum		Waveguide straight section (no flanges)
WR284WGXXXXCY	Copper		Waveguide straight section with flanges on either end.
WR284WGXXXXAY	Aluminum		Waveguide straight section with flanges on either end.

XXXX = Length in mm (+/-2 mm)

Y=Flange type (1, 2, 3 or 4) see flange section below for detailed descriptions.

Sample Part Number: WR340WG0250C2

- WR340 Waveguide Straight Section
- 250mm in Length
- Copper Material
- 2 Attached WR340FLAN2 Type Flanges

Flanges

Waveguide flanges are used to connect waveguide sections to one another.

Part Number	Waveguide Size	Description
WR430FLAN1	WR430	Brass, flat, pocket
WR430FLAN2		Brass, choke, pocket
WR430FLAN3		Aluminum, flat, pocket
WR430FLAN4		Aluminum, choke, pocket
WR340FLAN1	WR340	Brass, flat, pocket
WR340FLAN2		Brass, choke, pocket
WR340FLAN3		Aluminum, flat, pocket
WR340FLAN4		Aluminum, choke, pocket
WR340FLAN5		Stainless steel, choke, pocket
WR284FLAN1	WR284	Brass, flat, pocket
WR284FLAN2		Brass, choke, pocket
WR284FLAN3		Aluminum, flat, pocket
WR284FLAN4		Aluminum, choke, pocket



Richardson Electronics offers custom waveguide components designed to your specifications. If you do not see what you are looking for in our catalog, please contact your local sales representative for further details.

2450 MHz: Microwave Leakage Meters

MLT441:

Panel mount for easy integration/installation in existing equipment

MLT442:

19" rack, for easy mounting in cabinets or table top use.

Features:

- CE certification
- Threshold detection and switching for microwave power at 2450MHz
- Equipped to accommodate 1 to 4 measuring probes.
- Sensitivity level can be manually set from 0.5 to 10mW/cm²
- LCD display informs the following details:
 - Status
 - Actual measured data
 - Set point for threshold switch
 - Language
- Equipped with "watch-dog" circuitry to check the functions of the processor
- Line voltage: 85 to 265VAC

Dimensions:

MLT441: 300mm * 200mm * 80mm

MLT442: 478mm * 295mm * 88mm (19" rack)

Measuring sensor: diameter 20.5mm * 80mm

Sensor Specs:

Calibrated frequency: 2450MHz

Ambient temperature: 10 to 40 Deg. C

Max. field strength: 2.0mW/cm²

Measuring distance: 50mm

(Distance between the sensor head and area to be measured or supervised.)



MLT4 Series Hand-held Leakage Meters

MLT4A: 0 to 2mW/cm²

MLT4B: 0 to 10mW/cm²

MLT4C: 0 to 5mW/cm² (non-linearized)

Features:

- Hand-held instrument
- LED-scale
- Overrange acoustic signal

Dimensions:

Case: 120mm * 65mm * 40mm

Total: 205mm * 65mm * 40mm

Battery control (9V alkaline)

Specs:

Display: LED-scale 11 steps

Accuracy: +/-1dB, calibrated at 2450MHz

Performance density: Max., 2.0mW/cm²

Working temperature: 10 to 40 Deg. C



915 & 2450 MHz: Microwave Leakage Meters

Richardson offers microwave leakage detectors from Holaday Industries and other quality manufacturers. These detectors aid in protecting personnel and assist in meeting government regulations for microwave radiation.

The following hand-held models are of a meter and probe style. They feature a hand-held probe to check areas for microwave radiation without exposure to the operator. The meters are virtually immune to failure caused by excessive fields, completely portable, and battery-operated. They feature battery and meter checks to ensure proper operation of both the microwave equipment and meter.



Model HI-1501

The HI-1501 is a meter and probe style. It features a hand-held probe to check areas for microwave radiation without exposure to the operator. The meter is virtually immune to failure caused by excessive fields, completely portable and battery operated. It features battery and meter checks to ensure proper operation of both the microwave equipment and meter.

Specifications:

- Calibrated at 2450 MHz
- Ranges: 0-2, 0-10, 0-100 mW/cm²
- Accuracy: ± 1 dB (0-2 and 0-10 scales)
- Maximum power density: 2.0 W/cm²



Model HI-1801

The HI-1801 is a meter and probe style. It features a hand-held probe to check areas for microwave radiation without exposure to the operator. The meter is virtually immune to failure caused by excessive fields, completely portable and battery operated. It features battery and meter checks to ensure proper operation of both the microwave equipment and meter.

Specifications:

- Calibrated at 2450 MHz
- Range: 0-10 mW/cm²
- Accuracy: ± 1 dB
- Maximum power density: Continuous 2.0 W/cm²



Model HI-1600

The HI-1600 is of a meter and probe style. It features a hand-held probe to check areas for microwave radiation without exposure to the operator. The meter is virtually immune to failure caused by excessive fields, completely portable and battery operated. It features battery and meter checks to ensure proper operation of both the microwave equipment and meter.

Specifications:

- Calibrated at 915 MHz and 2450 MHz
- Three ranges: 0-10 mW/cm² at 2450 MHz, 0-10 and 0-20 mW/cm² at 915 MHz
- Accuracy: ± 1 dB
- Maximum power density: 2.0 W/cm²

Model HI-2602 - The HI-2602 interlock monitor provides continuous surveillance of 2450 MHz microwave fields for protection of personnel and equipment. The device detects and indicates fields from 0.2-2 mW/cm² through a remotely mounted probe using Holaday's patented microwave field sensor. Usable in any critical area, the panel-mounted HI-2602 interlocks with any alarm or microwave source. AC powered, adjustable alarm level.

Specifications:

- Calibrated: Standard is 2450 MHz. 915 MHz is available at an additional cost.
- 0.2 - 2.0 mW/cm²
- Accuracy: ± 1 dB
- Maximum power density: 2.0 W/cm²

915 MHz: Microwave Generators (Variable)

High Power, Complete Microwave Generators with Remote or Integrated Magnetron Head.

All of our microwave generators come standard with an isolator, RS232 interface, LCD screen and keypad control.

The following interface options are also available:

- CANbus
- ProfiBus
- Device Net
- RS485 interfacing.

Other options are available upon request. Please contact your local Richardson sales representative.



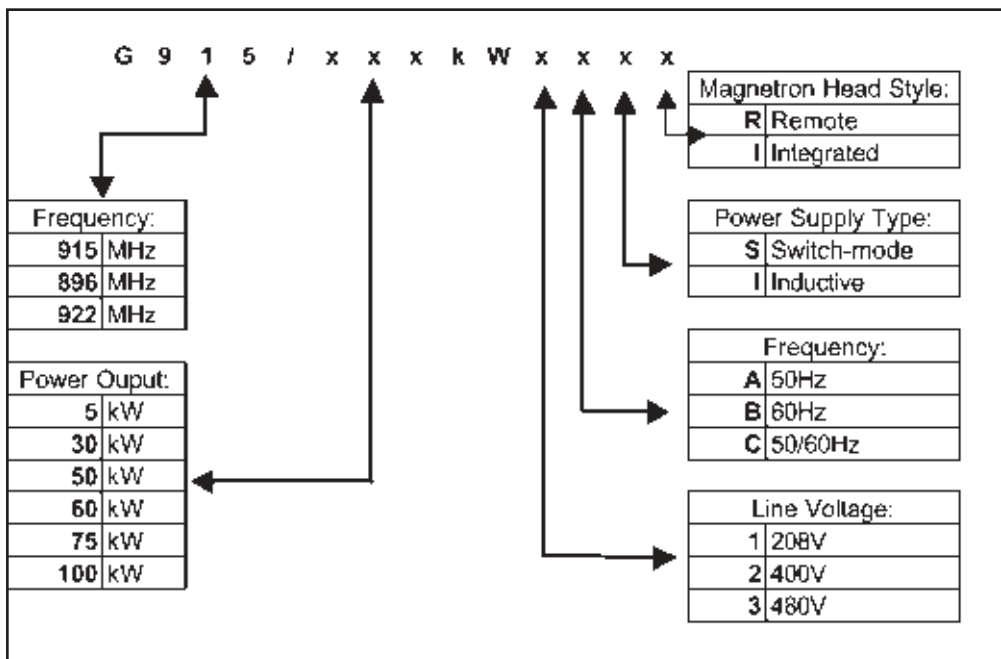
Max. Output Power	Freq. MHz	Cooling Type	Magnetron Head	Power Supply	Cable Set	Part Number
5kW	915*	Water	Remote or Integrated	Inductive or Switch-mode	Included	G915/5kWxxxx
30kW	915*	Water	Remote or Integrated	Inductive or Switch-mode	Included	G915/30kWxxxx
50kW	915*	Water	Remote or Integrated	Inductive or Switch-mode	Included	G915/50kWxxxx
60kW	915*	Water	Remote or Integrated	Inductive or Switch-mode	Included	G915/60kWxxxx
75kW	915*	Water	Remote or Integrated	Inductive or Switch-mode	Included	G915/75kWxxxx
100kW	915*	Water	Remote or Integrated	Inductive or Switch-mode	Included	G915/100kWxxxx

* Also available in 896 & 922MHz

Part Numbering System

Example Part Number: **G915/60kW3BSR**

915MHz, 60kW MW generator with remote magnetron head and switch-mode power supply. 480V/60Hz.



915 MHz: Magnetrons and Solid State Generators

Magnetron: A low-cost, efficient cross-field microwave oscillator used for the generation of continuous-wave (CW) signals.

Below is a partial listing of magnetrons we offer from stock. We also offer custom design, testing and cross referencing.



Part Number	Frequency (MHz)	Output Power (kW)	V _f (V)	I _f (A)	V _a (kV)	I _a (A)	I _{ap} (A)
NLM915-100	915	100kW	14	110	17.5	6.0	6.5
NLM915-75	915	75kW	12.6	112	17	5.0	6.0
NLM915-60	915	60kW	12.6	112	17	4.5	5.0
NLM915-50	915	50kW	12.6	112	17	4.0	5.0
NLM915-30	915	30kW	12.6	112	15	3.0	4.0
NL10257	915	5kW	10.0	35	6.5	1.3	1.6

Notes: Magnetrons also available in 896 & 922 MHz.
 All magnetrons require both water and air cooling.
 Socket compatible with Burle and CTL magnetrons.
 Rebuilt magnetrons are available. Please contact your local Richardson sales office for details.

915MHz Solid State Generators

Part Number	Frequency	Max Output Power
NLSS915-150	915MHz	150 Watt
NLSS915-600	915MHz	600 Watt



System Features

Protection functions:

- Auto/manual reset
- Audible indication (User enable/disable)
- Maximum forward power
- Maximum VSWR (By internal isolator)
- Over temperature

Connectors:

- AC mains, receptacle, EMI filtered
- Source output: BNC (F)
- RF input: BNC (F)
- RF output: Type N(F)
- Interface: 15 pin D(F), EMI filtered

Interface functions:

- Standby (C/F)
 - Thermal (F)
- C= Control input
 F= Flag output

Controls, front panel:

- AC power on/off
- Forward/Reflected RF power
- Standby

Front panel indicators:

- AC power on
- Standby
- RF power control
- RF power display
- Over temperature



5kW

- MG7.5PSM/415
- MG7.5PSM/480

The MG7.5 magnetron power supplies each comprise a single power module, measuring 10 1/2" x 19" x 19". They are designed to power CW magnetrons with RF output powers of 5kW @ 915MHz.

The units also contain the filament supply, magnet supply board, and the interface circuits between the user's system and the power supply. The high voltage output of the module is applied to the cathode of the magnetron. Magnetron output power is controlled by the anode current. At turn on, the filament current is first applied for the pre-heat period, followed by the anode voltage and current ramps. Provision is made in the control unit to allow local control of the output voltage and current. Filament current foldback is automatically adjusted according to the value of the anode current.



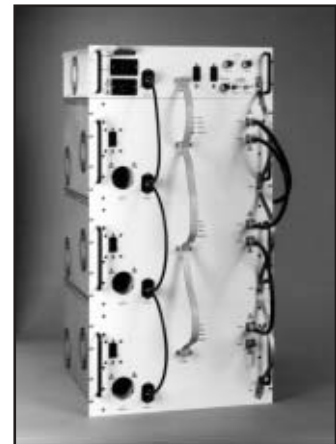
30kW

- MG36PS415
- MG36PS480

The MG36 magnetron power supply comprises three 12kW power modules, each measuring 10 1/2" x 19" x 19" to drive a 30kW magnetron. The units also contain the filament and magnet power supplies and the interface circuits between the user's system and the power supply.

The high voltage outputs of the modules are connected in parallel and applied to the cathode of the magnetron. At turn on, the filament and magnet currents are first applied for the pre-heat period, followed by the anode voltage and current ramps.

Provision is made to allow local control of the output voltage and local or remote control of the output current. RF output power is controlled by the anode current. The filament current foldback is automatically adjusted according to the value of the output current.



50-100kW

- MG72PS480/415
- MG84PS480/415
- MG120PS480/415

The MG72-MG120 series magnetron power supplies are comprised of multiple 12kW power modules, each measuring 10 1/2" x 19" x 19" to drive a 50-100 kW magnetron. The units also contain the filament and magnet power supplies and the interface circuits between the user's system and the power supply.

The high voltage outputs of the modules are connected in parallel and applied to the cathode of the magnetron. At turn on, the filament and magnet currents are first applied for the pre-heat period, followed by the anode voltage and current ramps. Provision is made to allow local control of the output voltage and local or remote control of the output current. RF output power is controlled by the anode current. The filament current foldback is automatically adjusted according to the value of the output current.



915 MHz: Component Sets

Component Sets

A multitude of ancillary components used to transmit, measure and alter the microwave energy generated from the magnetron. These component sets usually include a magnetron, waveguide launcher, circulator, water-load and a power supply.



Description	5kW	30kW	50kW	60kW	75kW	100kW
CW Magnetron	NL10257	NLM915-30	NLM915-50	NLM915-60	NLM915-75	NLM915-100
Waveguide Launcher	NL10257-LAUNCH	WR975LAUND	WR975LAUND	WR975LAUND	WR975LAUND	WR975LAUND
Electromagnet	NL10257-ELECTRO	WR975EMB	WR975EMB	WR975EMB	WR975EMB	WR975EMB
Upper Pole Piece	—	WR975UPPA-1	WR975UPPA-1	WR975UPPA-1	WR975UPPA-1	WR975UPPA-2
Lower Piece	—	Included with WR975EMB	Included with WR975EMB	Included with WR975EMB	Included with WR975EMB	Included with WR975EMB
Filament Connector Set	NL10257-CONN	NL915CONNA	NL915CONNA	NL915CONNA	NL915CONNA	NL915CONNA
3-Port Circulator	WR975ISOL5A	0915.201.124.00 or WR975CIRC50A	0915.201.304.00 or WR975CIRC100A	0915.201.304.00 or WR975CIRC100A	0915.201.304.00 or WR975CIRC100A	0915.201.404.00 or WR975CIRC100A
Dummy Water Load	Water Load Included	0915.203.303.00 or WR975LOAD30A	0915.203.303.00 or WR975LOAD30A	0915.203.303.00 or WR975LOAD30A	0915.203.303.00 or WR975LOAD30A	WR975LOAD150A or WR975LOAD30A
Power Supply*	MG7.5PSM/208 MG7.5PSM/415	MG36PS415 MG36PS480	MG72PS415 MG72PS480 MG7.5PSM/480	MG72PS415 MG72PS480	MG84PS415 MG84PS480	MG120PS480 MG120PS415

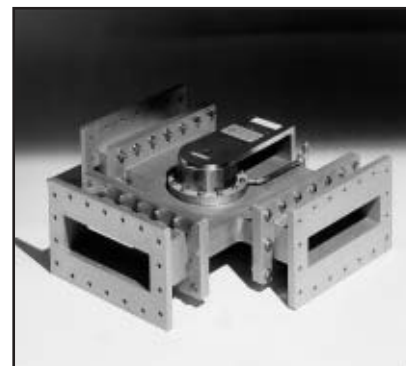
Note: Magnetrons are also available in 896 & 922 MHz.

* See page 26 for detailed descriptions of power supplies.

915 MHz: Waveguide Components

Circulators and Isolators

A circulator is a passive, non-reciprocal device with three or more ports used to transmit microwave energy in a specific direction. Additionally, circulators are used to prevent reflected microwave energy from the load, thus preventing excessive magnetron heating or moding. An isolator is a circulator with a water or dry load attached to a port and is used to absorb the reflected energy.



Part Number	Freq. (MHz)	Rated Forward Power (kW)	Min. Isolation (dB)	Max. Insertion Loss (dB)	Max. VSWR	Flange Type	Dummy Load	Recommended for use with Magnetron
0915.201.404.00	915	100	—	—	—	EIA CPR975*	WR975LOAD150A	NLM915-100
WR975CIRC100A	915	100	19	0.2	1.2:1	EIA CPR975*	WR975LOAD30A	NLM915-75 NLM915-60 NLM915-50
WR975CIRC100B	922	100	19	0.2	1.2:1	EIA CPR975*	WR975LOAD30B	NLM922-75 NLM922-60 NLM922-50
WR975CIRC100C	896	100	19	0.2	1.2:1	EIA CPR975*	WR975LOAD30C	NLM896-75 NLM896-60 NLM896-50
0915.201.304.00	915	75	20	0.1	—	EIA CPR975*	0915.203.303.00	NLM915-75 NLM915-60 NLM915-50
0922.201.304.00	922	75	20	0.1	—	EIA CPR975*	0922.203.303.00	NLM922-75 NLM922-60 NLM922-50
0896.201.304.00	896	75	20	0.1	—	EIA CPR975*	0896.203.303.00	NLM896-75 NLM896-60 NLM896-50
WR975CIRC50A	915	50	20	0.2	1.25:1	EIA CPR975*	WR975LOAD30A	NLM915-30
WR975CIRC50B	922	50	20	0.2	1.25:1	EIA CPR975*	WR975LOAD30B	NLM922-30
WR975CIRC50C	896	50	20	0.2	1.25:1	EIA CPR975*	WR975LOAD30C	NLM896-30
0915.201.124.00	915	30	20	0.1	—	EIA CPR975*	0915.203.303.00	NLM915-30
WR975ISOL5A	915	5	20	0.3	1.2:1	EIA CPR975*	Integral Dummy Load	NL10257
WR975ISOL5B	915	5	20	0.3	1.2:1	EIA CPR975*	Integral Dummy Load	NL10257

* British 18-Hole Flange Available Upon Request.

915 MHz: Waveguide Components

Water Loads

A water-load is used to absorb microwave energy from a system. It is often used as a test load for generators and as the terminating load in an isolator.

Part Number	Freq. (MHz)	Rated Power Level (kW)	Flange Type
WR975LOAD150A	915	150	EIA CPR975
WR975LOAD30A	915	100	EIA CPR975
WR975LOAD30B	922	75	EIA CPR975
WR975LOAD30C	896	75	EIA CPR975
0896.203.303.00	896	30	EIA CPR975
0915.203.303.00	915	30	EIA CPR975
0922.203.303.00	922	30	EIA CPR975



Auto & Electrical Tuners

Auto & electrical tuners utilize motorized tuning stubs electronically controlled either remotely or by a microprocessor to match the load impedance with the source impedance. Auto & electrical tuners minimize the amount of reflected power, which results in the most efficient coupling of power to the load. Auto-tuners are generally used in applications where the load impedance varies significantly due to variations in the load.

Waveguide	Frequency	Waveguide Size	Description
WR975ELECTUNE3A/B*	915MHz	WR975	3-Stub electrical tuner. Tuning stubs are motorized and controlled remotely.
WR975AUTOTUNE3A/B*	915MHz	WR975	3-Stub tuner automatic tuner. Reacts to the amount (amplitude) of the reflected power.
WR975ECOTUNE3A	915MHz	WR975	3-Stub tuner automatic tuner. Reacts to the amplitude and phase of the reflected power.

* A= 19" Rack Mount Controller
B= Panel Mount Controller

3-Stub Tuners

Tuners are waveguide components used to match the load impedance with the source impedance. Tuners minimize the amount of reflected power, which results in the most efficient coupling of power to the load.

Part Number	Freq.	Max. Power (MHz)	VSWR (kW)	Waveguide Size
WR975TUNER3A	915	45	1.5:1	WR975
WR975TUNER3B	915	75	1.5:1	WR975

Note 1: E/H Tuners also available.

Note 2: 4 & 5 stub tuners and a 3 stub auto-tuner is available upon request.

Bends

Waveguide bends are used to change direction in the waveguide transmission system.

Part Number	Material	Waveguide Size	Description
WR975EBA	Aluminum	WR975	E-Plane sweep 90° bend
WR975HBA	Aluminum	WR975	H-Plane sweep 90° bend

Note: 45° and mitered bends are also available upon request.



915 MHz: Waveguide Components

Couplers

Directional couplers are waveguide components used to measure forward and/or reflected microwave energy.

Part Number	Freq. (MHz)	Coupling Factor	Directivity	Waveguide Size	Description
WR975SDCN*	915**	60	27dB	WR975	Single directional coupler with a female N-type connector.
WR975DDCA	915**	N/A	20 dB	WR975	Dual directional coupler with 2, BNC output detector diodes.
WR975DDCB	915**	N/A	20 dB	WR975	Dual directional coupler, includes galvanometers for reading forward & reflected power.
WR975DDC60A*	915**	60	27 dB	WR975	Dual directional coupler with female N-type connectors.

* Additional coupling factors available on request (e.g. 30 dB, 50 dB and 60 dB).

** 896 & 922 MHz couplers available on request.

Coax Transitions

Coaxial adapters are waveguide components used to convert from standard waveguide to a specified coaxial waveguide connector.

Part Number	Max. Power (kW)	VSWR	Waveguide Size	Description
WR975/COAXTRANS	0.3	<1.15	WR975	Waveguide to N-type connector.
WR975/COAX7/16	1.2	<1.15	WR975	Waveguide to 7/16" connector.
WR975/COAX7/8	2.0	<1.15	WR975	Waveguide to 7/8" connector.
WR975/COAX1-5/8	5.0	<1.15	WR975	Waveguide to 1 5/8" connector.

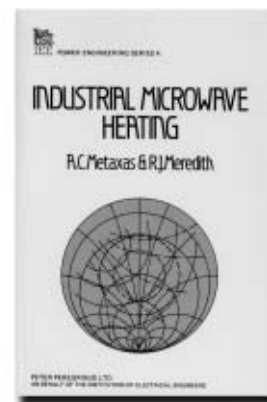
INDUSTRIAL MICROWAVE HEATING

by A. C. Metaxas and R. J. Meredith

Order No. PUB-101

This book offers a broad coverage of the theory and practice of industrial microwave heating. It introduces the physical processes behind dipolar and conductivity loss mechanisms and follows with a thorough presentation of dielectric property data of many industrial materials as a function of the moisture content, temperature and frequency, focusing on the interpretation of such data with regard to the suitability for processing these materials with microwave energy. The basic equations which govern the power dissipation, attenuation, phase constant, penetration depth, and skin depth are derived from first principles while the transport equations of heat, mass and pressure are qualitatively described, giving particular emphasis to the physical mechanisms behind high frequency drying.

The book provides established procedures backed by theoretical formulations for the design of industrial travelling wave and multimode applicators. It provides extensive coverage of single mode fundamental or higher order resonant cavities and it outlines a number of atypical applicator structures. It describes the essential features of processing with microwaves under vacuum and presents a brief introduction to the mechanisms which lead to gas breakdown. It stresses the need for a degree of hybridization with other electrical or conventional heating systems and discusses a few such schemes. The book outlines a number of systems for limiting leakage from on-line industrial microwave systems and concludes with an extensive discussion of successful industrial applications.



915 MHz: Waveguide Components

Straight Sections

Straight waveguide is supplied either as a raw cut waveguide section or with flanges attached. The length of a straight waveguide piece is measured from face to face of the flanges. We also offer painted and special plating (e.g. irridite) options. Please contact us for a quote.

Part Number	Material	Waveguide Size	Description
WR975WGXXXXC	Copper	WR975	Straight section (no flanges)
WR975WGXXXXA	Aluminum	WR975	Straight section (no flanges)
WR975WGXXXXCY	Copper	WR975	Straight section with flanges on either end.
WR975WGXXXXAY	Aluminum	WR975	Straight section with flanges on either end.

XXXX = Length in mm (+/-2 mm)

Y = Flange type (1, 2, 3 or 4) see flange section below for detailed description.

Sample Part Number: WR975WG0422A3

- WR975 Waveguide straight section
- 422mm in length
- Aluminum material
- Two attached WR975FLAN3 type flanges

Flanges

Waveguide flanges are used to connect waveguide sections to one another.

Part Number	Waveguide Size	Description
WR975FLAN1	WR975	Brass, Flat, Pocket
WR975FLAN2	WR975	Brass, Choke, Pocket
WR975FLAN3	WR975	Aluminum, Flat, Pocket
WR975FLAN4	WR975	Aluminum, Choke, Pocket

Richardson also offers the following waveguide components in WR284, 340, 430 & 975:

Sliding Shorts • Step Twists • Gas Barrier Windows • Tees & Folded Tees • Flexible Waveguide • Slotted Waveguide • E/H Tuners • Mitered Bends

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