CPI Electron Device Business - Magnetron Transmitter

The VPW-3504, 1 MW peak power, magnetron RF transmitter is part of a fully integrated magnetron transmitter family for use as a high power source of RF power for commercial applications including weather radar, cargo screening, and electromagnetic vulnerability testing. This microwave transmitter uses a CPI EDB coaxial magnetron as its RF output device. The frequency of operation is magnetron dependent. Any CPI EDB magnetron with RF power range up to 1.5 MW can be used in this transmitter. CPI EDB provides any modifications required for the particular magnetron chosen. CPI EDB is able to furnish a compact, user-friendly, microwave power source while being cost-effective for our customers.

The transmitter cabinet contains the high voltage power supply, magnetron, solid state switch, and the high voltage tank assembly which includes the pulse transformer, energy storage high voltage capacitor, and filament power supply.

CPI EDB provides a complete cabinet with a touch screen controller and dual-directional coupler which is part of the CPI EDB control system for monitoring forward and reflected power. A circulator can also be integrated into this cabinet for an additional cost.

FEATURES:

- 1 MW peak power RF output
- Compatible with multiple magnetrons
- VSWR protection
- Modular design for ease of customization
- Touch screen local control with Ethernet connectivity for remote control / monitoring
- Air cooled

BENEFITS:

- CPI EDB Magnetrons and modulators ensure compatible performance
- Transmitter is compatible with magnetrons at various power levels and frequencies
- Easy to use and user friendly
- Built in diagnostics and BIT for local or remote troubleshooting.

APPLICATIONS:

- Instrumentation radar
- Weather radar
- EMI/EMC field testing

The CPI EDB subsystem components are a high voltage power supply that provides >5 kW of energy to the solid state switch assembly. The solid state switch assembly is co-located with the high voltage pulse assembly so that there is minimal inductance in the buss-line that is carrying the current to the step-up transformer. In addition to the step-up transformer in the high voltage pulse assembly there is the energy storage capacitor, corner cutter and the filament transformer.

The high voltage power supply is a 19 inch rack mount unit, 5U high by 22 inches deep. It is completely self-protected with over current and input under/over voltage circuits. The high voltage power supply converts input AC into DC then switches it utilizing a short-circuit proof series resonant inverter. The filament power supply needed to operate the magnetron is contained in this unit. This is adjustable and has an automatic de-rate for duty cycle adjustment. Cooling is accomplished by internal fans.

Cathode pulsing is done by a completely solid-state array of IGBT switch boards that is driven by the control interface board in the high voltage power supply. This switch inherently limits current and pulse energy by design, no external circuitry is required for these functions. The IGBT switch is also a current controlled switch, set by a bias voltage from the high voltage power supply control interface board. The voltage across the switch will change automatically as the voltage across the magnetron changes due to frequency and temperature changes. This switch also will inherently limit arc current in the event of a magnetron high voltage arc. The limit is less than twice the normal operating current in the event of a complete short circuit. The switch assembly has integral fans to cool the switches.

All high voltage is contained in a sealed tank. The pulse transformer that steps up the high voltage power supply output to the peak voltage that the magnetron requires, the storage capacitor bank to supply the energy during the pulse, the corner cutter to shape the voltage pulse to ensure low-jitter operation and the magnetron filament DC filter are all contained in this oil tank. The magnetron is mounted external to the high voltage tank for ease of replacement. External fans are provided to cool the magnetron. Both it and the solid-state switch are thermally interlocked as they can be damaged if sufficient cooling is not supplied.

The cabinet is self-cooled with integral fans. The cabinet has approximate dimensions of 22.6 inches wide, 37 inches deep and 61 inches high. The cabinet weight is approximately 725 pounds without the magnetron. Total weight is 800 pounds including a typical 1 mW magnetron.

Instrumentation and Control

Front Panel Control and Display

The magnetron transmitter has a touch screen computer control system that accepts control inputs and provides status, fault/alarm conditions, and metered parameter information. This information is available on the front panel screen of the transmitter and also via an Ethernet connector. The table on page 3 defines the specific control functions, monitored test points on the front panel, transmitter operating status, fault/alarm conditions, and metered voltages, currents, and operating times.

The front panel consists of the touch screen that allows for individual controls and as well for operation remotely through the Ethernet connection. Analog test points are available for diagnostic and performance assessment on the rear panel. These test points are buffered to allow the use of standard test equipment such as oscilloscopes, RF spectrum analyzers, and RF power meters.

The remote interface utilizes an Ethernet IP address with CPI EDB standard protocol and command set. All the front panel information and functions that are available on the

control panel are also available via the remote interface. In order for transmitter to be remotely operated, the front panel must be commanded to remote. The analog test points are not remotely available.

Pulsed operation and timing are derived from an externally supplied modulator gate signal. This gate will determine the duration of the output RF and pulse repetition frequency (PRF). Internal monitoring circuits will ensure that the acceptable pulse width, PRF, and duty cycle limits of the transmitter are not exceeded. This modulator gate signal is not part of the serial interface and must be supplied separately via a dedicated RS-422 differential line driver.

Fault Protection

Monitor and shut off triggers for:

- Peak and average cathode current
- Filament power supply regulation and current
- Excessive duty cycle from gate signal
- High voltage under voltage and over current
- Low voltage power supply under voltage
- Excessive temperature
- External safety interlock

Control Functions

- Main power On/Off (front panel circuit breaker)
- Transmit/standby (RF On/Off)
- Fault reset
- Local/remote select
- Peak power adjust
- Magnetron frequency tuning

Fault Display

- Fault sum
- Interlocks open (external or cover)
- Magnetron average over current
- Magnetron peak over current
- High voltage low
- High voltage current high
- Filament voltage
- Filament current
- Over temperature
- Low voltage power supply
- Drive power supply
- Duty cycle high
- Fault log
- Tuner fault

Rear Panel Monitoring

- RF output sample port (–50 dBm nominal, Type “N”)
- Magnetron pulse current (0.1 V/A)
- Trigger sample

Display Monitoring

- Power on
- Heater time delay
- Standby
- Transmit (RF On)
- Local/remote
- Beam elapsed hour meter
- Heater elapsed hour meter
- Magnetron average current
- High voltage
- High voltage power supply current
- Filament voltage
- Filament current
- Transmit frequency

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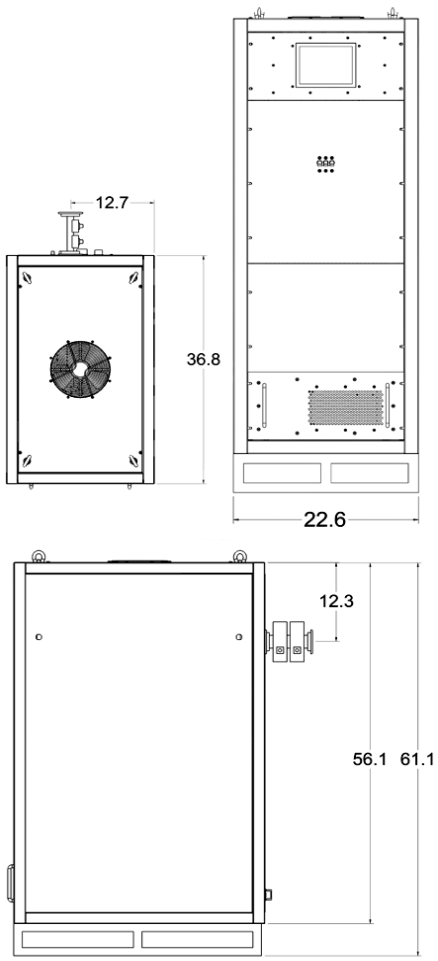
ETHERNET

Control Signals	Description	Comments
Control Inputs	Power on Radiate Input Gate Reset	RS-422 only, variable width
Control Adjustments	Peak current adjust Frequency adjust	Available at touch screen and remotely Available at touch screen and remotely 10 selectable frequencies in the magnetron operating band
Status Outputs	Mod Normal	Normal operation – no faults, x 5 internal reset
	LVPS fault	LVPS < 80% nominal
	HVPS fault	HVPS < 80% nominal
	Filament PS fault	Out of regulation
	Magnetron Over I	Avg. current > 100ma, peak current > 100a
	Over duty	Duty over .001
	Over-temp	Excess temperature
	Interlock	Open interlock
Meter Outputs	Pulse avg. current High voltage power supply V Mod avg. current Filament V Filament current Filament hours Radiate hours Internal temperature	



Electrical Parameters

Frequency Range	Depends on magnetron selected
RF Output	Up to 1.5 MW depending on magnetron
Duty Cycle	0.0001 Typical
Pulse Width	.2 mS to 5 mS (continuously variable)
Maximum PRF	2 KHz
Prime Power	208 VAC (3 phase with neutral) 50/60 Hz

Mechanical and Environmental Parameters

Ambient Temperature	-10C to +50C operating
Shock and Vibration*	Ground benign (typical transportation)
Cooling	Air cooled
RF Output Connection	Waveguide
Control I/O	Ethernet
Dimensions (width)	19 inch (48.3 cm) rack
Dimensions (height)	61 inch (154.9 cm) max.
Dimensions (depth)	37 inches (94 cm)max .
Weight	725 lbs. (328 kg) without magnetron

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