



ENI Products



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OEM-25B

RF Plasma Generator



HIGH RF VOLTAGES MAY BE PRESENT AT THE OUTPUT OF THIS UNIT. All operating personnel should use extreme caution in handling these voltages and be thoroughly familiar with this manual.



DO NOT USE ANY CFC (CHLOROFLUOROCARBON) SOLVENT IN THE MAINTENANCE OF THIS PRODUCT. In recognition of our responsibility to protect the environment, this product has been manufactured without the use of CFCs. The no-clean flux now used in all soldering operations may leave a small inert residue that will not affect the performance of the product. The use of CFCs for cleaning or maintenance may result in partial liquification of the no-clean flux residue, which will damage the unit and void the warranty.



This product is manufactured at an MKS Instruments' ISO-9001:2000-Quality-System-compliant facility.

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Manual Order Number: 1040-001

Revision Level: D 11/15/06

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Warranty

MKS, ENI Products warrants to the original purchaser for a period of one year from the date of delivery, each instrument to be free from defects in materials and workmanship. For a period of one year, MKS, ENI Products will, at its option, adjust, repair, or replace defective parts, without charge to the original purchaser, so that the instrument performs according to its specifications.

When warranty service is required, the instrument must be returned, transportation prepaid, to the factory or to one of MKS, ENI Products' authorized service centers. If, in MKS, ENI Products' opinion, the instrument has been damaged by misuse, improper site preparation or installation, or by other causes not covered by this warranty, MKS, ENI Products will be billed for the cost of parts and labor at standard rates. In this case, the original purchaser will be billed for the cost of transportation.



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Service And Technical Assistance

For Service or Repair contact the closest Customer Service Department with the following information:


- Model and serial number
- Purchase order number
- Detailed description of malfunction
- Your company's "Bill To" and "Ship To" address

You will receive a RMA (Return Materials Authorization) number, the warranty status of the unit to be returned and estimated repair charge, if any. The RMA number is your authorization number. Please type this number on your purchase order and shipping label. After MKS, ENI Products receives the unit, a firm quote and estimated date of completion will be given.

For Technical Assistance for your particular application, contact the nearest MKS, ENI Products Sales and Service Center. The following information will help us provide you with prompt and efficient service:

- All of the information contained on the unit's nameplate.
- Names and telephone numbers of important contacts.
- Detailed description (i.e. physical damage and/or performance anomalies, quantitative and/or qualitative deviation from specifications), including miscellaneous symptoms, dates and times.
- The environment and circumstances under which the issue developed.
- Supporting test data and/or records that can be provided.
- Any previous, related conversations and/or correspondence with MKS, ENI Products.

Sales & Service Locations

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GERMANY	Sielminger Str. 63 D-70771 Leinfelden- Echterdingen (Stetten) Stuttgart, Germany	Tel: 49-711-947700 Fax: 49-711-9477025
JAPAN	1-21-15 Aoyagi Kunitachi Tokyo 186-0013 Japan	Tel: 81-425-229-011 Fax: 81-425-222-636
KOREA	1 st Floor, DK Plaza-I 375-1, Geumgok-dong City Bundangogu, Seongnam Kyonggi-do, Korea 463-805	Tel: 82-31-717-9244 Fax: 82-31-717-9244
SINGAPORE	Blk 4010 Techplace 1 #01-07/08/09 Ang Mo Ko Ave 10 Singapore 569626	Tel: 65-6451-1062 Fax: 65-6451-0172
TAIWAN	2F, No. 47, Ln. 2, Sect. 2 Kuang Fu Rd. Hsinchu 300 Taiwan, ROC	Tel: 886-3-575-3040 Fax: 886-3-575-3048
P.R. of CHINA	West end of 2 nd floor, No. 3 building (T20-3) No. 258 Jinzang Rd., Shanghai Jin Qiao Export Processing Zone Pudong, Shanghai 201206 P.R. of China	Tel: 86-21-5834-7934 or 86-21-5834-7914 Fax: 86-21-5834-7794

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Operation Manual	Rev #: D	Eff. Date: 11/15/06

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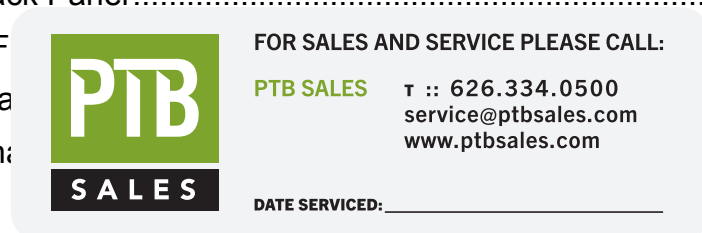
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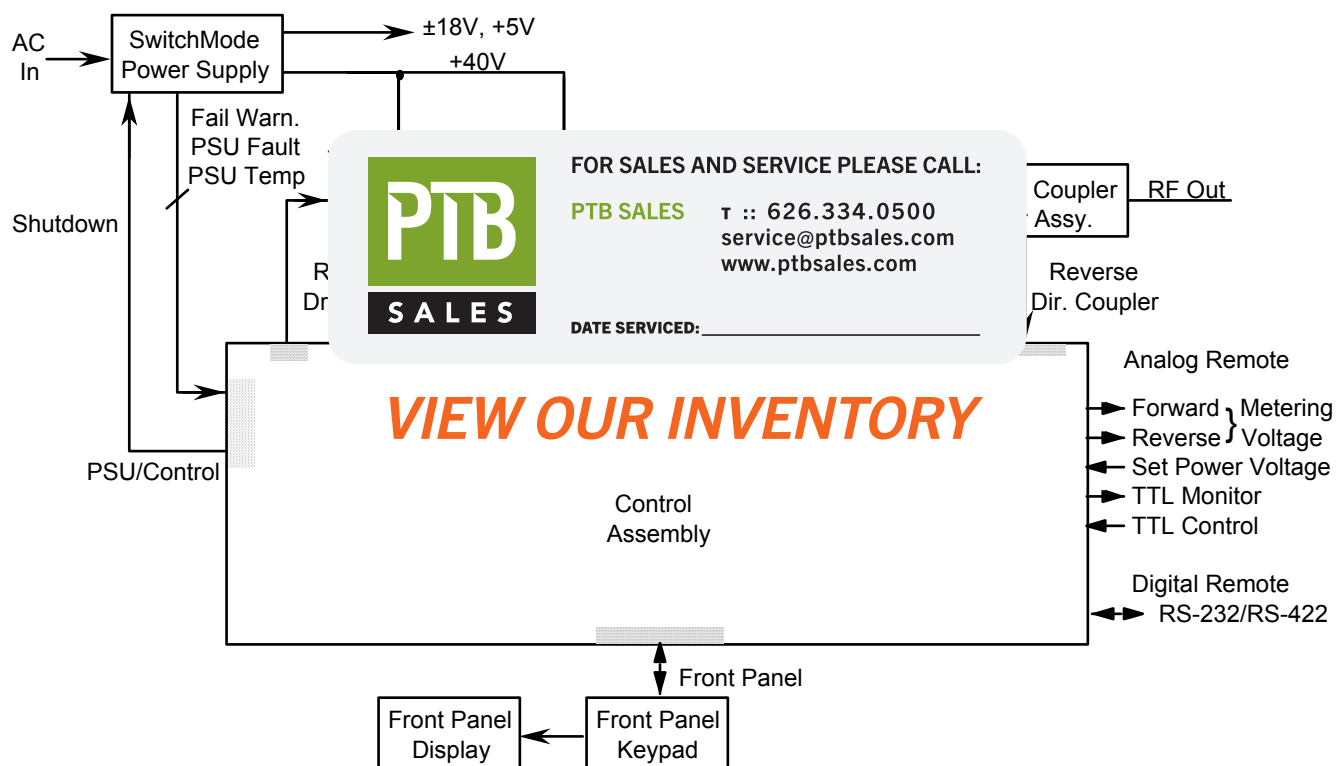
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The following diagram outlines each assembly's function.



OEM-25B Overall Block Diagram

Figure 1


Documentation Conventions

Many parts of this manual refer to computer commands and data. It is important to recognize the conventions used in this manual in order to understand the meaning of these commands.

Angle Brackets < > These brackets are shown for command parameters. They are used to indicate a range of values and should not be used for values that are not ranges.

Round Brackets () These brackets are used to indicate optional parameters. They are used to indicate a range of values and should not be used for values that are not ranges.

Square Brackets [] These brackets are used to indicate a name for special control codes or non-printable characters. Examples of commonly used control codes are listed below.



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[LF]	Line Feed	(0Ah)
[CR]	Carriage Return	(0Dh)
[ESC]	Escape	(1Bh)

This manual is divided into four chapters and an appendix. Please refer to the following descriptions to help you locate the information you need.

Chapter 1	Deals with precautionary details. Please read this section if you are unfamiliar with the OEM-25B or MKS, ENI Products' warranty procedures.
Chapter 2	Tells you how to install and power up the system for the first time.
Chapter 3	Describes operational details of the OEM-25B.
Chapter 4	Provides troubleshooting solutions to common problems in operating the OEM-25B.
Appendix A	This appendix provides complete operating specifications for the OEM-25B.

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Chapter 1

Safety

It is essential to read and understand the information contained in this manual before installing, operating, or servicing this equipment. Proper use of the equipment, with the proper training and safety procedures, will ensure safe operation and promote reliable performance. However, the manufacturer cannot be held responsible for any injury or damage resulting from the use of the equipment. The manufacturer will encourage a safe operating or service environment for all individuals.

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Certain safety-related considerations must be observed before installing, operating, or servicing this equipment. Symbolic and/or textual labels and markings are used in and/or on the equipment, as well as in this product manual, to convey and/or identify such important information. Among other things, this information is provided to alert equipment operators and service personnel to hazardous conditions that may result in personal injury and/or damage to the equipment. Please look for these labels and markings and follow their direction.

1.1 Symbols

The following symbols appear in and/or on the equipment either as silk-screened markings or as part of adhesive labels.

1.1.1 Exclamation Point Within a Triangle



Symbol Definition: Caution, refer to accompanying documents.

The “exclamation point within a triangle” symbol (reference ISO Publication 3864, No. B.3.1) is used in and/or on the equipment to alert the installer, operator, or service personnel to the presence of important related installation, operation, and/or service instructions and to direct such personnel to the product manual for that information. This symbol is also used within the product manual itself to identify important instructions.

1.1.2 Lightning Bolt within a Triangle



Symbol Definition: Caution, risk of electric shock

The “lightning bolt within a triangle” symbol is used in IEC Publication 417, Symbol No. 5140, and ISO Publication 3864. This symbol is used on the equipment to alert the installer, operator, or service personnel to the risk of electric shock. Personnel should not attempt to open the equipment enclosure or remove covers or panels without the proper knowledge of the voltages existing within the equipment. This symbol is also used within the product manual itself to identify important operating and/or maintenance instructions, which, if not followed carefully, could result in personal injury or even death.



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1.1.3 Non-ionizing Electromagnetic Radiation Warning Triangle



Symbol Definition: Caution, non-ionizing electromagnetic radiation

The “non-ionizing electromagnetic radiation warning triangle” symbol (reference IEC Publication 417, Symbol No. 5140, and ISO Publication 3864) is used on the equipment to alert the installer, operator, or service personnel that the equipment is capable of producing elevated, potentially dangerous, levels of non-ionizing electromagnetic radiation, particularly RF radiation.

1.2 Adhesive Labels

The following adhesive labels appear in and/or on the equipment.

1.2.1 Nameplate

This OEM-25B nameplate identifies the unit's general category (or serial number).



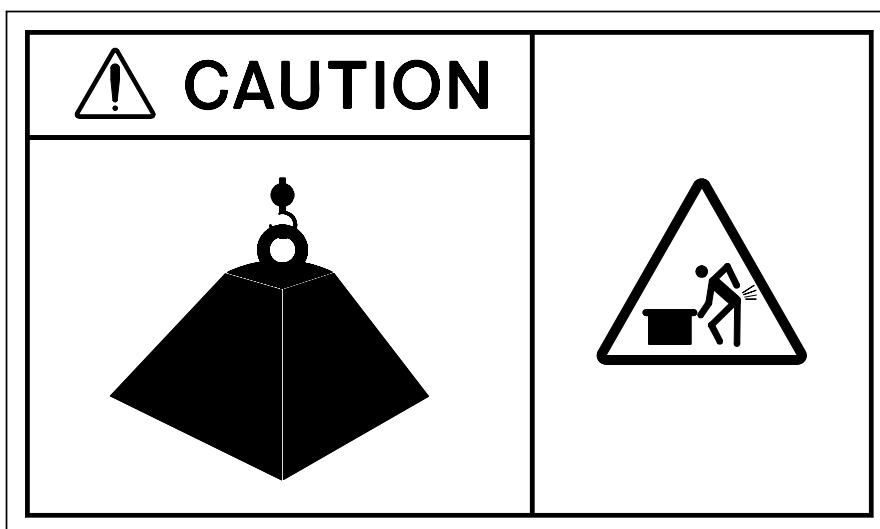
- | | |
|---|---|
| <p>A. Manufacturer:
MKS, ENI Products
100 Highpower Road
Rochester, NY 14623-3498 USA
Model No.:
Identifies the general category of ENI products to which the unit belongs.</p> | <p>E. Input:
Identifies the AC input ratings (voltage, current and frequency) of the unit.</p> |
| <p>B. Part No.:
Identifies the top-level ENI part number that uniquely defines product construction/configuration of the unit.</p> | <p>F. Output:
Identifies the RF output ratings (power and frequency) of the unit.</p> |
| <p>C. Serial No.:
Identifies the serial number of the unit. This number (sequentially assigned as the product is manufactured) corresponds only to the individual unit bearing this label.
ENI Rev.:
Identifies the revision level of the ENI part number that appears in line “B” above.</p> | <p>G. Customer P/N:
Identifies the customer part number that corresponds to the unit.
Rev:
Identifies the revision level of the customer part number that also appears in line “G”.</p> |
| <p>D. Weight:
Identifies the nominal weight of the unit in both kilograms and pounds.
Date:
Identifies the date of manufacture (MM/DD/YY convention) of the unit.</p> | |

1.2.2 Service Warning Label



This external label can be found centered and forward-justified on unit's top cover panel.

1.2.3 Heavy Object Warning Label



This external label can be found centered and forward-justified on unit's top cover panel, just rearward of the Service Warning Label.

1.2.4 Exclamation Point within a Triangle Label



This external label can be found on the rearward-facing surface of the metal cover that restricts access to the line-side terminals of the EMI filter.

1.2.4 Light



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This label can be found internally (with unit's top cover panel removed) on the top surface of the clear, polycarbonate cover that restricts access to the circuit breaker terminal area and externally on the rearward facing surface of the metal cover that restricts access to the line-side terminals of the EMI filter.

1.2.5 RF Radiation Warning Triangle Label



This external label can be found on the unit's rear panel adjacent to the RF Output port.

1.3 ***Silk-screened Markings***

The following silk-screened markings appear in and/or on the equipment.

1.3.1 **RF Output Port Warnings**



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This pair of external symbolic markings can be found on the unit's rear panel adjacent to the RF Output port.

Chapter 2

System Installation



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2.1 Initial

2.1.1 Mechanical Inspection

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If damage to the shipping carton is evident, request the carrier's agent be present when the unit is unpacked. Check for equipment damage and inspect the cabinet and panels for dents and scratches.

2.1.2 Claim for Damage

Please notify MKS, ENI Products directly or your authorized MKS, ENI Products representative if the OEM-25B is mechanically damaged or fails to meet specifications upon receipt. Retain our shipping carton and packing material for the carrier's inspection, as well as for subsequent use to return the unit should this become necessary.

2.1.3 Packaging for Reshipment

Whenever possible, the original shipping carton and packing material should be used for reshipment. If the original packing material is not available, wrap the instrument in heavy paper or plastic. Use a strong shipping container. If a cardboard carton is used, it should be at least 200-lb. test material.

Use shock-absorbing material around all sides of the instrument to provide a firm cushion and to prevent movement inside the container wall on each side. Protect the front panel by means of cardboard spacers inserted between the front panel and the shipping carton. Make sure that the instrument cannot move in the container during shipping. Seal the carton with a good grade of shipping tape and mark the container: **FRAGILE! ELECTRONIC INSTRUMENT.**

*Drain water before shipment.*

2.2 Installation Requirements

2.2.1 Rack Mounting

The unit is provided with rack-mounting ears to allow installation in JIS standard racks. The rack must provide a shelf on which the generator rests. Front panel rack-to-ear mounting hardware must be customer supplied.

2.2.2 Cooling and

Water Flow



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Connections are provided to accept 1/4-inch NPT male pipe fittings. Connect the appropriate customer-supplied fittings for the customer's water system. The unit is designed to operate normally with not less than 7.0 liters per minute. If the available process water flow is near this flow rate, the actual flow should be checked.

The OEM-25B is protected against damage caused by lack of coolant flow. However, inadequate coolant flow will result in an OVERHEAT condition and the generator will turn off its RF power until normal internal temperatures are restored.

Distilled water should be used to eliminate possible build-up of corrosion or scale inside the heat sink tubing and copper heat exchanger. Poor water conditions will reduce the electrical ruggedness of the OEM-25B by reducing the amount of cooling available to the power transistors.



If conditions exist where the water coolant temperature is below the ambient dew point temperature, MKS, ENI Products recommends that either 1.) in-line solenoid valves be installed on the water connections to the generator and be closed when generator RF has been disabled or 2.) coolant water temperature be adjusted to prevent condensation.

Follow this recommendation to prevent condensation from forming when the generator is off; failure to do so may result in extensive damage to the generator! Contact MKS, ENI Products Service for more information.

If tap water with a high mineral content is used for cooling, it may be necessary to periodically flush the unit by pumping a commercial lime- or scale-removing agent through the unit. Typically, this agent is a household or industrial product. The unit should be flushed for approximately five minutes or until the scale is totally removed. Consult the factory for further recommendations.

Ventilation

Adequate air space (2" or 5 cm) should be provided around the sides and rear of the unit for convection cooling.

2.2.3 Remote Control Connector Assembly

Each generator must be supplied with a connector that will plug into the remote control connector. **VIEW OUR INVENTORY**

1. R
2. T
3. Connect wires to the connector terminals as explained in section 3.2.
4. Replace the cable clamp and hood. Tighten all screws.
5. Tighten the cable clamp screws so that the cable is held securely without any pinching.



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2.3 AC Input

2.3.1 Power Source

The OEM-25B is characterized by the following nominal AC Input ratings:

3/PE ~ 200 000VA ~ 400V 50/60Hz ~ 20A

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2.3.2 Power Cable **VIEW OUR INVENTORY**

The OEM-25B comes equipped with a four-conductor, size 10 AWG AC power cord. The free end of this power cord is not terminated and must therefore be prepared by the installer for connection to the local AC power supply. For reference, the black wire, the red wire and the white wire are the three phase conductors, and the green wire serves as the protective earth (ground) conductor for the unit. The green wire must be correspondingly connected to frame ground through the AC distribution panel of the system into which the unit is installed.

If the installer properly terminates the free end of the OEM-25B power cord with a suitable plug-type connector, then the unit may be either bench mounted or permanently installed into an equipment rack. Otherwise, in order to maintain Product NRTL approval, this generator must be permanently installed into an equipment rack. In either case, the installation must also comply with the applicable local installation codes for electrical equipment.

2.4 System Interconnection

The following diagram shows the normal interconnection of an OEM-25B to a system:



The RF Out connection is made to either a load (often a plasma chamber) or a matching network.

2.4.1 RF Coaxial Cable

RG-393 coaxial cable or equivalent is recommended.

2.4.2 I/O Cabling

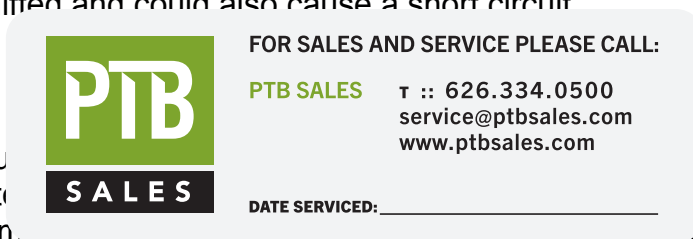
I/O cables use subminiature D-type connectors. The following features are required to ensure that radiated emissions and electromagnetic immunity requirements are met:

1. Shielded cable (Alpha Suprashield 5110, 5120 or equivalent) must be used for I/O connections.
2. A shielded connector backshell (AMP 745171/2/3 shielded cable clamps or equivalent) must be used. The cable shield must be connected to the connector backshell.
3. The connector shell must be grounded to the equipment chassis with jackscrews or clips.

2.5 System Check

The following items should be checked before applying power for the first time:

1. Check for any physical damage that could affect safety. For instance, a dent could indicate that internal components could have shifted and could also cause a short circuit.
2. Be sure the unit is in the correct position.
3. Make sure the power cable is correctly connected. This term is used to describe the power cable. trip. assis.
4. Ensure that the interlock circuit is closed at the accessories connector, located on the rear panel. If an interlock circuit is not being used, the interlock can be satisfied by plugging a connector in with Pins 3 and 21 jumpered together (see section 3.2.3).
5. Connect the output of the power generator to a suitable 2500 W, 50Ω load.
6. Finally, check all cables, making sure that they are correctly installed and firmly inserted.




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2.6 Initial Turn-on Procedure

The following procedure outlines how the OEM-25B should react as power is applied for the first time.

1. Ensure that proper coolant flow has been established. Connect the RF output to a 50Ω dummy load.
2. Turn on the power to the OEM-25B. The status should be normal, indicating that there are no faults. The forward meter field should closely agree with the set field.
3. Turn on RF power. The status should be normal, indicating that there are no faults. The forward meter field should closely agree with the set field.
4. Use the set point buttons to obtain at least 2500 W of forward power. MAX POWER may be indicated at 2500 W or less if there is appreciable reflected power from the RF load. This is normal.
5. Select load leveling. The display will switch to the LOAD field and should read the same as when forward leveling is selected.
6. Reselect forward leveling and turn off RF power.
7. Disconnect the OEM-25B output connector from the 50Ω load and turn on RF power. Observe that, when in forward leveling mode, the reverse meter reading should be 500 W and the forward meter should agree closely. MAX REVERSE should be indicated, showing that the OEM-25B is being limited by the internal protection circuit and is no longer controlled by the front panel set point buttons.
8. Use the set point buttons to reduce the output power below 500 W. The MAX POWER indication should be removed as normal power control and leveling is restored.
9. Use the set point buttons to reduce the output power to zero. There should be no power reading. Turn off the AC line switch.
10. The initial test is now complete.

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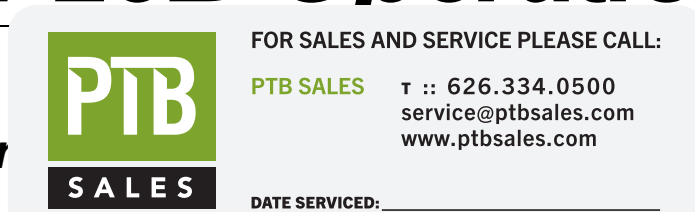
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Chapter 3

OEM-25B Operation

3.1 From



Please refer to the Mounting & Outline Drawing in the rear of this manual.

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3.1.1 Vacuum Fluorescent Display

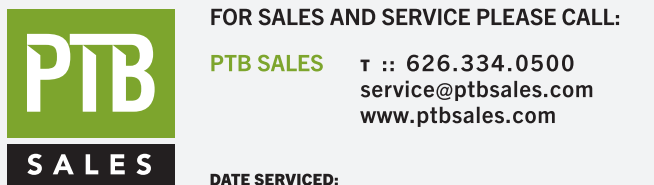
The OEM-25B display consists of two lines of 20 dot-matrix characters that are used to display the present operating status of the generator. Each field in the display is grouped by a front panel marking to indicate its purpose.

- The **Forward** field displays the generator's forward power when the leveling mode is set to forward leveling.
- The **Load** field displays the generator's load power when the leveling mode is set to load leveling.
- The **Reverse** field displays the generator's reverse power.
- The **Status** field indicates either:
 - The operating status of the generator.
 - The error status if a fault has occurred.
- The **Set Point** field shows the currently selected power set point that is used when generator RF output is enabled (with RF ON button).
- The following LEDs provide annunciation of specific generator settings:
 - Remote Enable (in button)
 - RF On
 - Fault
 - Remote

3.1.2 Controls

The front panel incorporates six momentary push buttons for control of the generator and one switch for power on/off.

- The **Remote Enable** button is used to enable remote control via the analog remote control connector. If remote enable is selected, the "Remote" input selects whether control is by the
- The
- The
- The
- The **Fault Reset** button allows faults to be reset if the generator is now in an operational state. Also, pressing this button will cause RF to be turned off.
- The **Set Power** buttons allow the output power to be ramped up and down between zero and 2500 W.
- The **Main Breaker** allows the AC power to the generator to be protected and switched on and off.



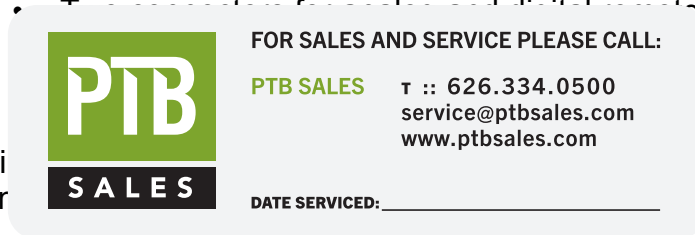
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3.2 Back Panel

Please refer to the Mounting & Outline Drawing in the rear of this manual. The back of the OEM-25B contains

- One terminal block for AC power input
- One connector for RF output
- The connector for analog and digital remote control

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3.2.1 RF Output Connector

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The RF output of the generator is delivered through this “HN” connector. The "Caution High RF Voltage" indicates that an AC potential of up to 500 V may appear between the center pin of the connector and ground. Normal caution should be exercised when working with these voltages.

3.2.2 Water Input/Output Connectors

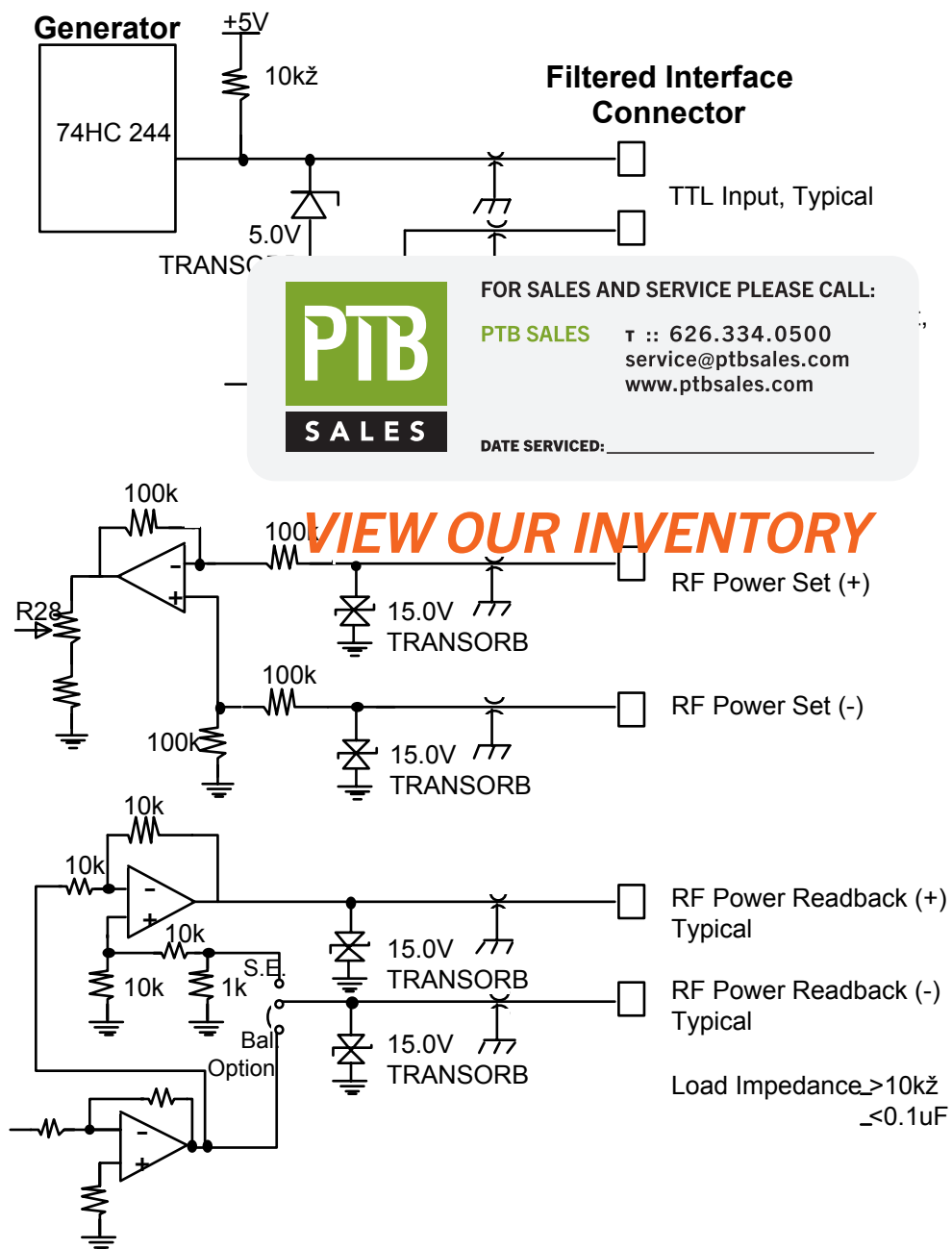
The water inlet and outlet connectors are provided for attachment of a water-cooling system having a minimum flow rate of 7.0 liters per minute. The connections provided accept a 1/4-inch male (NPT) pipe thread. The water inlet temperature must not exceed +35°C.

3.2.3 Analog Remote Control Connector

Connector P3 allows remote control and monitoring of the OEM-25B generator functions, using analog control voltages and TTL/Open collector logic signals.


Note: *A differential-output option is internally jumper-selectable on the interface board. If selected, the negative-going output should not be ground-referenced. For those systems that ground the negative output, the single-ended output option must be selected. P10 selects the forward-output option while P11 selects the reverse-output option.*

Consult table 3.2.3 for a complete description of each pin's function.



Analog Remote Control

Figure 3.2.3a

Pin	Function	Description
1	+5 V Pull-Up	+5 V supply with 100 Ω internal resistor. This is used to power LEDs in a remote test box.
2 20	RF On Input	This TTL input allows RF to be turned on and off when the generator is in remote mode. A logic low is required to turn RF on. Pin 2 is the input; Pin 20 is the ground reference.
3 21	Interlock OK Input	This TTL input must be low to allow RF to be turned on. Pin 3 is
4 22	Alarm Res	<div>  <p>FOR SALES AND SERVICE PLEASE CALL: PTB SALES T : 626.334.0500 service@ptbsales.com www.ptbsales.com DATE SERVICED: _____</p> </div> <p>if the generator is operational, 10ms is required to ground reference.</p>
5 23	Remote	<p>if the front panel has "remote enable" selected. A logic low selects remote mode. Pin 5 is the input; Pin 23 is the ground reference.</p>
6 24	Load-Leveling Input	This TTL input is used if option jumpers P8 and P9 are installed on the interface board. If in remote mode, a TTL logic low places the generator in load leveling mode. Pin 6 is the input; Pin 24 is the ground reference.
8 26	Power On Readback Output	This open collector output indicates that power is on when Pin 8 is active low. Pin 26 is the ground reference.
9 27	RF On Readback Output	This open collector output indicates that RF is on when Pin 9 is active low. Pin 27 is the ground reference.
10 28	Remote Readback Output	This open collector output indicates that the generator is in remote mode when Pin 10 is active low. Pin 28 is the ground reference.
11 29	Alarm Readback Output	This open collector output indicates that the generator is in a faulted inactive state when Pin 11 is open. Pin 29 is the ground reference. Active low indicates a normal condition.
14 32	RF Power Set Input	This analog input allows control of the generator output when the generator is in remote mode. The input is scaled so that a differential value of 10 V causes an output power of 2500 W. Pin 14 is the positive-going input and Pin 32 is the negative-going input of a differential amplifier.
16 34	Forward Power Readback Output	This analog output indicates the forward power of the generator. The output is scaled so that a differential output of 10 V represents a Forward Power of 2500 W. Pin 16 is the positive going output and Pin 34 is the negative going output. See note at the beginning of this section for P10.
17 35	Reverse Power Readback Output	This analog output indicates the reverse power of the generator. The output is scaled so that a differential output of 10V represents a reverse power of 500W. Pin 17 is the positive going output and Pin 35 is the negative going output. See note at the beginning of this section for P11.

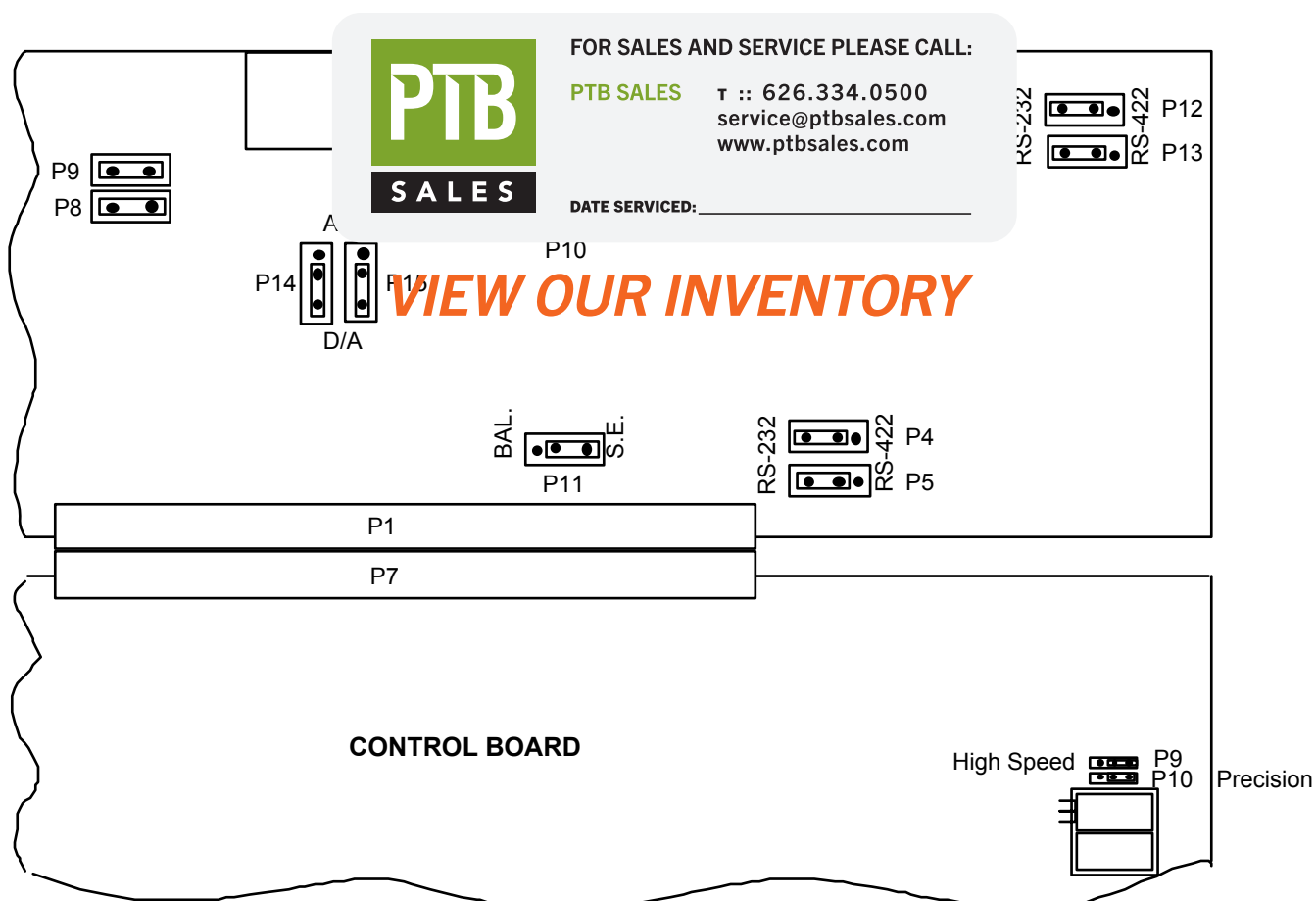
Note: No Connection on Pins 7, 12, 13, 15, 18, 19, 25, 30, 31, 33, and 36.

Analog Remote Control Connector

Table 3.2.3

Analog Remote Configuration Options

Jumper plugs are provided on the interface board for configuring the analog outputs as either single-ended ground-referenced or balanced outputs. If the RF power readback (-) lines are to be grounded, place shorting jumpers on the pins located next to the S.E. label as shown in the following diagram.



Analog Remote Configuration Options

Figure 3.2.3b

Analog Readback Voltage Options

Option jumpers are also provided on the control board for selection of high-speed analog readback or digitally compensated analog readback voltages. Position shorting bars are at control board P9 and P10 as shown in the above diagram. Shorting pins nearest the P9 and P10 labels provide analog output voltages with digitally corrected accuracy.

Remote Load Leveling Selection

An option jumper may be installed at P8 to allow remote control over selection of generator load power-leveling mode of operation. If remote load power selection is desired, short the pins of P8 together.

3.2.4 Digital Remote Control Connector

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Pin 1	Rx -	Pin 6	RTS -
Pin 2	Tx +	Pin 7	CTS +
Pin 3	Rx +	Pin 8	RTS +
Pin 4	Rx -	Pin 9	RTS -
Pin 5	GND		

P2 Digital Interface

Table 3.2.4a

Hardware Configuration

RS-232 or RS-422 operation is selected by the position of four three-pin jumpers on the interface board (P4, P5, P12, P13).

Figure 3.2.3b shows the jumpers configured for RS-232 operation.

RS-422 operation is selected by moving the jumpers so that the right-most two pins are shorted. A standard, 9-way female “D” connector provides the electrical connection as defined below:

Pin	Function	Description
1	Tx Data -	This pin is the minus (-) side of the RS-422 Tx data output.
2	TX Data +	This pin provides either the plus (+) side of the RS-422 TX data output, depending on jumper P5's position.
3	Rx Data -	This pin provides either the minus (-) side of the RS-422 Rx data input, depending on jumper P12's position.
4	Rx Data +	This pin provides either the plus (+) side of the RS-422 Rx data input, depending on jumper P12's position.
5	Digital Ground	This pin is connected to the digital ground of the controller.
6	CTS -	This pin is the minus (-) side of the RS-422 CTS signal input.
7	CTS +	This pin provides either the plus (+) side of the RS-422 CTS signal input or the RS-232 CTS signal input, depending on jumper P5's position.
8	RTS +	This pin provides either the plus (+) side of the RS-422 RTS signal output or the RS-232 RTS signal output, depending on jumper P12's position.
9	RTS -	This pin is the minus (-) side of the RS-422 RTS signal input.

RS-422 Pin-out Configuration

Table 3.2.4b

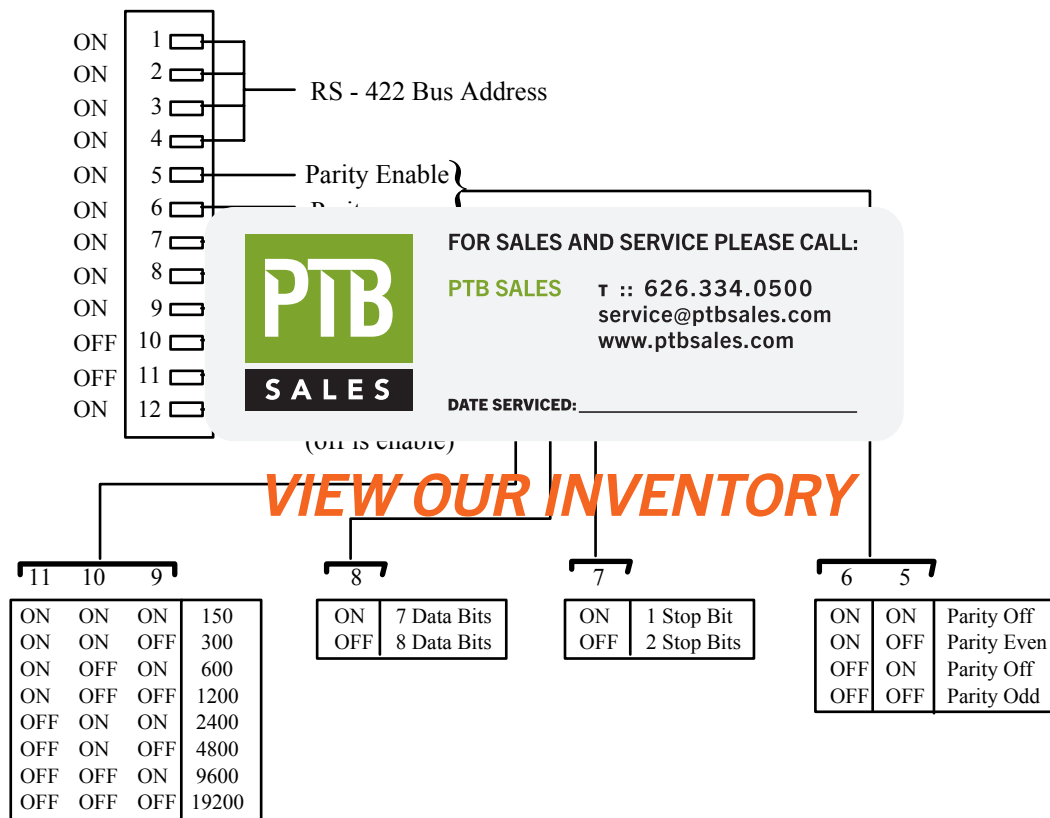
Serial Remote Control Selections

The CPU card contains one 12-way DIP switch that selects the function of the serial interface. The first four positions select the serial bus address and the remaining eight positions select baud rate and serial data format.

The DIP switch is only read when the power is turned on. It is necessary to remove and reapply power before the new setting is used by the controller. Note, the following serial configurations are not available:

- RX of 7 data, 1 stop, no parity
- TX of 8 data, 2 stop, parity

The DIP switches are configured as follows:



Serial Remote Control Selections

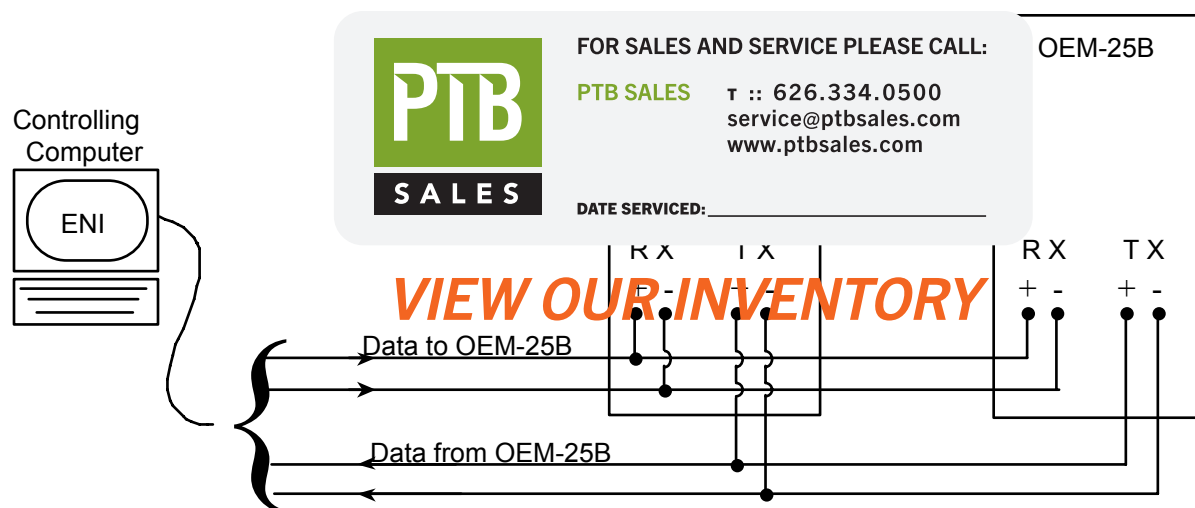
Figure 3.2.4a

When a switch is set to the ON condition (marked on switch package) the logic level is "0." For instance, to set the RS-422 bus address to 5, turn **on** switches 2 and 4 and turn **off** switches 1 and 3. This generates the code 0101 or 5 in hexadecimal format.

Verify that the bus address is set to **0000** for RS-232 operation.

RS-422 Busing

One controlling computer or terminal can be connected to more than one OEM-25B generator by connecting RS-422 **receive** and **transmit** data lines in parallel as shown in the following diagram.



RS-422 Busing

Figure 3.2.4b

When this mode of operation is used, it is necessary to use the IDE command and link release character as described in the sections entitled "Basic Monitor Commands" and "Link Release Character."

3.2.5 Communication Protocol

Data is transferred to and from the CPU using a simple ASCII protocol that functions with a standard terminal.

All commands are composed of three ASCII characters followed by numbers, where applicable, and terminated by a carriage return. All

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Upon receipt of a carriage return (0D), the controller returns a carriage return and a line feed (0A) so that the terminal screen is correctly formatted. In addition, an asterisk (*) is used to indicate that the command has been accepted and executed. If a bad command is received, a question mark (?) and bell character (07) are returned instead. The response is ordered as follows:

[CR] [LF] [*]
or [CR] [LF] [BELL] [?]

The protocol always returns one of these two responses after command execution. In addition, there are no unprompted responses with the exception of the power-up message.

The following commands illustrate the types of messages that are available and accompanying formats:

HEL	n	Causes a <u>help screen</u> to print. The required screen number is n.
RFV		Causes a <u>16-bit fault vector</u> to be reported, showing the system's health.
RUT		Causes total <u>on time</u> of the unit to be reported.

Space Characters

To allow screen formatting, space characters (20) are ignored. However, when received, they are returned on the serial link in the same way as any other character.

Illegal Commands

Unrecognized commands or out-of-range numerical values are ignored and annunciated by the return of a question mark character and a bell character. The same response occurs if the limits of the line buffer are exceeded (16 characters).

Note: A carriage return on its own is a valid command that does nothing (no operation).

Leading Zeros

The numerical value is maintained if leading zeros are sent.



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maintained if zero.

Special Characters

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Five characters have a special purpose and are the only characters not echoed on the serial link. The escape character allows the operator to break out of continuous loops. The control W character (^W) is used to maintain link integrity. The exclamation mark (!) is used to cause an immediate release of the RS-422 buffer if two consecutive exclamation marks are received in a row. The XON and XOFF characters (^Q and ^S) allow flow control out of the transmit serial port.

Link Integrity

This function is disabled when power is applied.

Upon receipt of the first ^W character, the link integrity function is enabled and a ^W must be received at the rate of one per second (or less). Otherwise, a link integrity fault will be generated and power output will be disabled.

Power-up Message

Power up is annunciated by a message terminated by a special prompt, an asterisk enclosed in curly brackets {*}. This is the only time that this prompt is used. Therefore, a controlling computer can use this to see that a unit has been powered up. The complete power-up string is as follows:

[CR] [LF] [message string] [CR] [LF] [BELL] [{] [*] [}]

Backspace Characters

Backspace or delete characters (ASCII 08 or 7F) allow limited editing. When one of these characters is received, the last character in the line buffer is deleted and the following three characters are returned:

[BS] [SPACE] [BS]

This ensures that a terminal screen backspaces its cursor and removes the character.

Escape

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character is

used to exit from this condition. Upon receipt of the escape character, the controller will terminate the loop and respond with the standard command completion string:

[CR] [LF] [*]

Link Release Character

When two exclamation marks are received immediately after one another, the controller instantly tri-states the RS-422 output. Collisions are thus avoided on the RS-422 bus if multiple controllers are being used. The correct way to switch from one controller to another is to execute a link release (!!) and then use the IDE command to select the new controller. The IDE command will work on its own, but will occasionally suffer from a collision when the old controller does not release before the new controller takes over.

XON and XOFF

When XOFF is received (control S), transmission of serial data is halted. When XON is received (control Q), transmission of serial data is restarted.

3.2.6 User Commands

OEM-25B specific user commands are grouped into the following four categories:

Commands:

- Basic Monitor
- Direct Control
- Release

Basic Monitor

The basic monitor controller software



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Command	Syntax	Description
HEL	<n>	Decimal values of n from 0 to 9 display each of the ten possible help screens. Values between A and F will show help screen 0. Values greater than sixteen show help screen 0.
CHK	<Addr> - <Addr>	This command calculates the checksum of the program memory range specified. The address may be in the range 0 to FFFF. The checksum is a simple additive type where each byte in the specified range is added to the next. If a range 0-FFFF is specified, the least significant two bytes will be the same as the internal checksum of the EPROM stored in locations FFFE and FFFF.
IDE	<Ident>	The Ident may have values from 0-255. However, the controller can only be enabled with values of 0-15 since it only has four switches for address selection. All other values will cause the controller to be disabled. This command works in association with the ident DIP switch. When the ident in the command is the same as the ident on the DIP switch, it is possible to communicate with the controller. If the ident does not match, communication is disabled. This command is designed to work with the RS-422 port only since the output buffer can be tri-stated, allowing a bus to be formed with multiple generators and/or MATCHWORKS®. The RS-232 port cannot be tri-stated.

Basic Monitor Commands

Table 3.2.6a

See also, Link Release Character in Section 3.2.5, and RS-422 busing in Section 3.2.4.

Readback Commands


The following commands are known as passive commands. They simply read back a value or status.

Command	Syntax	Description								
ACT	<->	Returns three power readback values and the system power)(Status optional dash is d.								
RE		number information								
ROF		for the controller and tuner unit.								
ROL		Returns the metered load power in watts using decimal format.								
ROR		Returns the metered reverse power in watts using decimal format.								
ROT		Returns the number of hours that the OEM-25B has had RF turned on.								
RSE		Allows the power set point loaded by the OEM command to be read back for verification purposes.								
RUT		Returns the total time in hours that the OEM-25B has been turned on.								
RVE		Returns the version number of the software. Numbers in front of the decimal point denote a major software revision while numbers after the decimal point denote a minor software revision.								
RFV	<=>	Returns a 16-bit value called the fault vector and is formatted as four hexadecimal digits. RFV <=> lists all errors in a word format so that interpretation of hexadecimal is not necessary if the equal option is used. Bits in the fault vector are positioned as follows: <table><tr><td>DIGIT 0</td><td>0 Overheat Fault 1 Interlock Open 2 Aux Fault 3 Overcurrent Fault</td><td>DIGIT 2</td><td>8 Internal (80C552) RAM Fault 9 External RAM Fault A Code ROM Fault B Spare</td></tr><tr><td>DIGIT 1</td><td>4 Max Reverse Power Fault 5 Max Forward Power Fault 6 PSU Fault 7 RF Metering Cable Break</td><td>DIGIT 3</td><td>F Spare E Spare D IIC Fault C Watchdog Timeout Fault</td></tr></table>	DIGIT 0	0 Overheat Fault 1 Interlock Open 2 Aux Fault 3 Overcurrent Fault	DIGIT 2	8 Internal (80C552) RAM Fault 9 External RAM Fault A Code ROM Fault B Spare	DIGIT 1	4 Max Reverse Power Fault 5 Max Forward Power Fault 6 PSU Fault 7 RF Metering Cable Break	DIGIT 3	F Spare E Spare D IIC Fault C Watchdog Timeout Fault
DIGIT 0	0 Overheat Fault 1 Interlock Open 2 Aux Fault 3 Overcurrent Fault	DIGIT 2	8 Internal (80C552) RAM Fault 9 External RAM Fault A Code ROM Fault B Spare							
DIGIT 1	4 Max Reverse Power Fault 5 Max Forward Power Fault 6 PSU Fault 7 RF Metering Cable Break	DIGIT 3	F Spare E Spare D IIC Fault C Watchdog Timeout Fault							

Readback Commands

Table 3.2.6b

Command	Syntax	Description				
RPS		Returns the generator status and is formatted with four ASCII hexadecimal digits. The four digits represent 8 status bits as follows: <table><tr><td>0</td><td>Overheat Fault</td></tr><tr><td>1</td><td>Interlock Open</td></tr></table>	0	Overheat Fault	1	Interlock Open
0	Overheat Fault					
1	Interlock Open					



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Readback Commands (Cont'd)

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Table 3.2.6b

Direct Control Commands

The following commands cause an immediate change to the system. Please note the following before employing any command:

1. The controller will respond with a question mark for the following commands when an out-of-range value is specified.

2. In the case of a question mark (*), the controller will respond with a question mark (*) when the command is inoperative (e.g., remote lamp lit). Read the manual for more information on command syntax.



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Command	Syntax	Description
REM	<Switch>	Allows selection of the analog or digital remote control when remote operation is enabled (REM 0 for analog, REM 1 for digital (serial)). Note that the following commands will only function if REM 1 has been used with remote enabled: OEM, OFF, TRG, LLT
LIT		Disables the link integrity function. See section 3.2.4.
OEM	<Power>	Allows the power set point to be changed. The power is entered in decimal watts between 0 and 2500.
OFF		Turns RF power off.
TRG		Turns RF power on at the power level selected by the OEM command.
LLT	<Type>	Allows either load leveling or forward leveling to be selected. A type of 0 selects forward leveling and a type of 1 selects load leveling.
BUT	<n>	Does the same as the front panel buttons. The value "n" selects the button to be pressed while 1 selects the top left button, 2 selects the button below it, 3 selects the next top left button over and so on. If the generator is in remote mode (remote lamp lit) the command only allows the remote enable button to be activated. This command <u>always</u> returns a * for valid buttons, irrespective of remote mode.
FRE		Causes all fault status bits in the system to be cleared as long as the actual faults have cleared.


Direct Control Commands

Table 3.2.6c

Remember, if any of the above commands are selected, a ? is returned to indicate out-of-range value errors, while an * denotes in-range values and the successful completion of any command.

Level A Extra Commands

The following commands are available after using the KEY <code> command. If the correct code is entered (code available for factory), these commands may be used until power is removed and reapplied or an invalid key code is entered.

Command	Syntax	Description
CAL	 <p>FOR SALES AND SERVICE PLEASE CALL: PTB SALES T :: 626.334.0500 service@ptbsales.com www.ptbsales.com</p> <p>DATE SERVICED: _____</p>	control.
FFI		generator.
XRT		RAM is good, a message of [PASS] is returned, if the RAM is bad, a message of [FAIL] is returned.

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Level A Extra Commands

Table 3.2.6d

Chapter 4

Troubleshooting

Refer to the Troubleshooting Guide for more information. OEM-25B.



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OEM-25B is one of the most reliable and efficient devices for generating the

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The first step in isolating a malfunction is to review the conditions under which the symptoms were observed. Unplug any rear panel interface connectors. Determine that the problem was not due to external cabling or abnormal line voltages. If the equipment is being operated by remote control, verify that proper commands are being received by the OEM-25B. After the problem has been definitely attributed to the OEM-25B, refer to the Troubleshooting Guide. Note that many of the circuits can be checked without the application of RF Power. A systematic fault-localizing procedure is mandatory for rapid troubleshooting. When the problem has been isolated to a particular circuit, refer to **Chapter S1, Technical Description** in the Service Manual as well as to the appropriate schematic for an explanation of the circuit.

Symptoms	Probable Cause	Recommendations
Vacuum fluorescent display does not light.	<p>Defective line cord or AC wiring.</p> <p>Cable to front panel display disconnected or HK supply AC cable disconnected.</p>	<p>Verify proper AC voltage at rear panel line terminals.</p> <p>Check cable connections.</p>
<div>  <p>FOR SALES AND SERVICE PLEASE CALL:</p> <p>PTB SALES T :: 626.334.0500 service@ptbsales.com www.ptbsales.com</p> <p>DATE SERVICED: _____</p> </div>		
Vacuum fluorescent display lights but no power-up message appears.	<p>EPROM not installed correctly.</p> <p>Micro-controller not powering up properly or I²C bus problem.</p>	<p>Check EPROM to ensure correct installation with Pin 1 properly oriented and no pins bent.</p> <p>Check +5 V supply at ICs on board. Check ALE for activity. Check SCL, SDA lines for activity or +5 V on these lines.</p>
INTERLOCK OPEN	Rear panel interlock circuit open.	Check connections at analog interface connector.
RF OVERHEAT	<p>PAI monitor cable disconnected.</p> <p>Reduced coolant flow or high coolant temperature.</p> <p>High reflected power.</p>	<p>Reattach cable. Verify thermal switch plug attached.</p> <p>Check system water flow per section 2.2.2 in this manual.</p> <p>Perform procedure for locating faulty RF module per section S2.3.1.2 in Service Manual.</p> <p>Check external tuner or load for proper operation.</p>
METER FAULT	Directional coupler detector to control board cable disconnected.	Reattach cable to "D" connectors at directional coupler and at control board.

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Symptoms	Probable Cause	Recommendations
MAX CURRENT	<p>High VSWR Load.</p> <p>Loss of PA transistor.</p> <p>Loss of power supply regulation.</p>	<p>Check MATCHWORK® tuning and reflected power level. Correct load problems.</p> <p>Check each PA current using FFI routine. Replace defective transistor.</p> <p>Check PSU output voltage if less than 39 VDC. Check AC line voltage. If above 180 V, check power supply.</p> <p>Check control board voltages.</p>
MAX REVERSE	<p>tuning and reflected power problems.</p>	
PSU OVERHEAT	<p>Defective internal fan.</p> <p>PSU temperature signal open or short.</p>	<p>Ensure fan rotor spins freely. Verify that fan power is OK. Replace fan.</p> <p>Verify continuity of cable and expected voltages at control board.</p>
PSU FAULT	<p>Interface board test jumper at P7 in service position.</p> <p>Short circuit failure of RF amplifier or P. S. output.</p> <p>Short circuit on +40 V line.</p>	<p>Be sure jumper is in normal position after service.</p> <p>Isolate short circuit and repair.</p> <p>Isolate short to PA modules of power supply by disconnecting supply wires at output studs. If short in supply, disassemble and isolate short. Check diodes on output rectifier card by measuring (at transformer) the secondary connections.</p>
PSU VOLT FAULT	<p>Controller detects main supply voltage is out-of-range.</p>	<p>Troubleshoot fiber-optic cables and controller shut-down line. Check FFI 3.</p>
WATCHDOG FAULT	<p>Failure of control board digital hardware.</p>	<p>Troubleshoot or replace control board assembly. Recalibrate unit.</p>
Incorrect front panel meter reading.	<p>Improper calibration of the meter or the VSWR Bridge.</p>	<p>Perform adjustment per sections S2.3.1.4 and S2.3.2 in the Service Manual.</p>



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Symptoms	Probable Cause	Recommendations
Low RF output.	Defective RF amplifier. Loss of power supply regulation.	Perform procedure for locating a faulty RF module per section S2.3.1.2 in the Service Manual. Check PSU output voltage. If less than 39 VDC, check AC line voltage. If above 180 VAC, troubleshoot power supply.
No RF output.	<div data-bbox="516 457 1218 682" data-label="Complex-Block"> <div>  <p>FOR SALES AND SERVICE PLEASE CALL: PTB SALES T :: 626.334.0500 service@ptbsales.com www.ptbsales.com</p> <p>DATE SERVICED: _____</p> </div> </div> <p>RF interface cables left disconnected during maintenance.</p> <p>Main power supplies inoperative or no RF drive.</p> <p>Defective output cable.</p>	<p>Verify connections of RF coaxial cables at output connector in the interface assembly F6 to the RF driver assembly J1; from the RF driver assembly output jack(s) J2 (J3) to the PA module input (s) J1 and the PA module output J2 to the combiner assembly (or low-pass filter assembly).</p> <p>With an external terminal, perform faultfinding routine. FFI 2 displays PA module current draw. 12-13 A is normal for full RF output. FFI 3 displays power supply output voltage measured at PA modules. 40 V \pm 2 V is normal with RF ON. 0V is normal with RF off.</p> <p>Visually inspect cable at output connector. Measure cable with ohmmeter.</p>

Appendix A

OEM-25B

Spec



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The following appendix lists complete physical and operation specifications for the OEM-25B.

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OEM-25B Specifications

RF Output:

Frequency	13.56 MHz
Frequency	<div>  <div> <p>FOR SALES AND SERVICE PLEASE CALL:</p> <p>PTB SALES T :: 626.334.0500 service@ptbsales.com www.ptbsales.com</p> <p>DATE SERVICED: _____</p> </div> </div>
Power Rating	2500 W into a 50 Ω load
Regulation Modes	Forward Power, Load Power
Set Point Range	0 - 2500 W (via Front Panel Controls) 0 - 2750 W (via ANALOG REMOTE Interface) 0 - 2500 W (via DIGITAL REMOTE Interface)
Regulation Tolerance (within power foldback limits; reference ENI Power Standard)	<u>$1:1 \leq \text{Load VSWR} \leq 3:1$</u> $\pm 2\%$ (for $200 \text{ W} \leq \text{set point} \leq 2750 \text{ W}$) $\pm 4\%$ (for set point $< 200 \text{ W}$)
Harmonic Distortion	$< -55 \text{ dBc}$
Line Related Noise	$< -55 \text{ dBc}$ (at rated power)
Non-Harmonic Spurious	$< -60 \text{ dBc}$
AC Line-to-Power Regulation	$\pm 0.5\%$ (for any line voltage change within ratings)
Power Output Meter	0–3000 W digital display with an accuracy of $\pm 2\%$ of power output. Simultaneous forward & reverse or load & reverse power indications.
Automatic FWD/LOAD Power LEVELING	2 W to maximum power output operating into any load within power foldback limits, locally or remotely controlled.
Power Foldback Protection	Automatic; occurs when reverse power reaches 500 W or power amplifier current exceeds preset limit.


Pulsed Operation

Rise time is less than 3.0 ms;
RF output may be controlled
simultaneously for amplitude and
pulse width by pulsing the RF power
set point.

Load Mismatch Tolerance

The units will operate continuously
into any load mismatch without

AC Input:

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%

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Connection

(No tap selection necessary)

10 AWG, 4-Conductor AC power cord
with no plug and no terminations. The
green wire is connected to the
generator chassis and serves as the
Protective Earth (Ground) conductor
for the unit. This conductor must be
correspondingly connected to frame
ground through the AC distribution
panel of the system. Refer to Section
2.3 *AC Input* for further details.

DIGITAL REMOTE Interface


9-pin "D" subminiature type
RFI suppression receptacle.

ANALOG REMOTE Interface

36-pin miniature-ribbon type
RFI suppression receptacle,
per customer requirement.

External RF ON/OFF Control

HCTTL-compatible; closure to ground
activates RF ON.

Forward Power Control (Analog Remote)	250 W/V factory calibration (i.e., 10 V = 2500 W)
Maximum RF Power Indicator	Enunciated in STATUS field on VF DISPLAY.
RF Power ON Signal	Open collector, transistor output; external pull up voltage 20V
Reverse RF Po	<div data-bbox="516 457 1218 688" data-label="Complex-Block"> <div>  <p>FOR SALES AND SERVICE PLEASE CALL: PTB SALES T :: 626.334.0500 service@ptbsales.com www.ptbsales.com</p> <p>DATE SERVICED: _____</p> </div> </div>
Forward RF Power Indicator	<p>± (2% of reading + 10 W)</p> <p>VIEW OUR INVENTORY</p> <p>Reading within 1 – 3000 W range; 250 W/V factory calibration (i.e., 10 V = 2500 W); Accuracy: ± 2 % (200 W ≤ set point ≤ 2625 W) ± 4 W (set point < 200 W)</p>
Maximum Operating Altitude	2000 m (6562 ft.) above sea-level
Cooling System	Combination of water-cooling and forced-air cooling.
Cooling Water:	
Inlet Temperature Rating	5 - 35 °C (41 - 95 °F)
Pressure Maximum	480 kPa (70 PSI)
Flow Rate Minimum	7.0 ltr/min. (1.8 gal./min.)
Connections	Accept ¼" male (NPT) pipe thread
External Ambient Air:	
Temperature Rating	5 - 40 °C (41 - 104 °F)
Relative Humidity Rating	80% RH (max.) at up to 31 °C (88 °F), de-rated linearly to 50% RH (max.) at 40 °C (104 °F)
Installation (Overvoltage) Category	INSTALLATION CATEGORY II: Local level, appliances, portable equipment, etc., with smaller transient overvoltages than distribution level and fixed equipment.

Pollution Degree

POLLUTION DEGREE 2:
Normally only non-conductive
pollution occurs. Occasionally,
however, a temporary conductivity
caused by condensation must be
expected.

Product Safety

NEC Listed to standards



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A2: 1995

Dimensions (H x W x D)

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200 mm x 480 mm x 638 mm
(7.9 in. x 18.9 in. x 25.1 in.)

Weight

35 kg (77 lbs.)

Rack Mounting

200 mm JIS rack-mounting ears
supplied.

Equipment Internal Fuse Ratings

Fuse F1 on Housekeeping Power
Supply PCB Assy (1001-138)
3AT, 250 V

The logo consists of a green square with the letters 'PTB' in white, and a black rectangle below it with the word 'SALES' in white.

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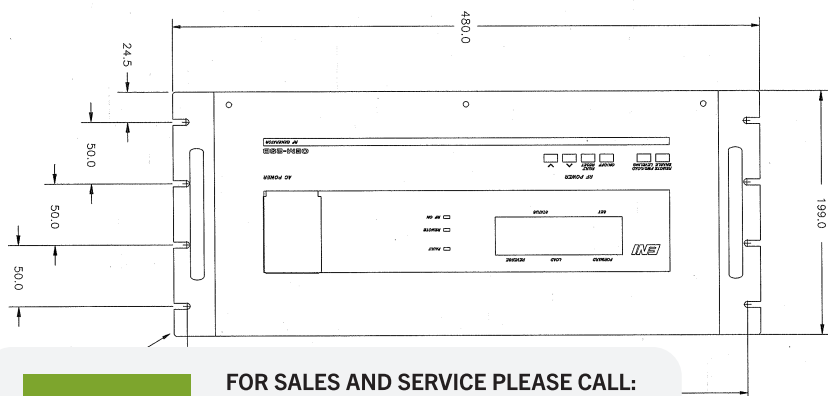
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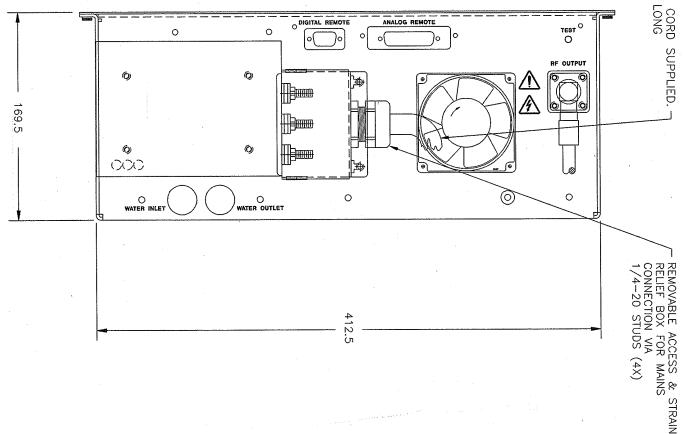
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