Advanced Microwave Technologies, Inc.

ADVANTECH

# INSTALLATION AND OPERATIONS MANUAL

## 1:1 REDUNDANT 100 WATT Ku-BAND HUB-MOUNT SOLID STATE POWER BLOCK UP-CONVERTER SSPBM – K100 - BRE

**PM 151-238413-2G0, Rev. 5**

# WARRANTY

This ADVANTECH Advanced Microwave Technologies Inc. product is warranted against defects in material and workmanship for a period of 2 years from the date of shipment. During the warranty period, ADVANTECH Advanced Microwave Technologies, Inc. will, at its option, either repair or replace the products that prove to be defective.

To return a product for warranty or repair service, you must first request a Return Material Authorization (RMA) number by contacting ADVANTECH at:

| | | |
|---|---|---|
| Phone: (514) 420-0045 | or | Fax: (514) 420-0073 |
| Website: www.AdvantechAMT.com | or | e-mail: Support@AdvantechAMT.com |

The unit should be shipped to the following address, in the original shipping container, with the prepaid shipping charges.

ADVANTECH Advanced Microwave Technologies Inc,
657 Orly Avenue
Dorval, Quebec
H9P 1G1
CANADA

Please indicate the RMA number on all shipping documentation.

Units shipped without a prior issued RMA, or not shipped in the original shipping container, may be subjected to rejection and returned at sender's expense.

## LIMITATIONS OF WARRANTY

ADVANTECH Advanced Microwave Technologies, Inc. warrants this product to be free of materials and workmanship defects.

The foregoing warranty shall not apply to defects resulting from improper handling or abuse by the purchaser, unauthorized modification, operating outside of the product's environmental specifications, improper installation or maintenance.

*ADVANTECH Advanced Microwave Technologies, Inc. shall not be liable for any direct, indirect, special, incidental or consequential damages.*

# CONTENTS

**Page**

# FIGURES

**Page**

# TABLES

**Page**

# 1. SAFETY

To prevent the risk of injury to personnel or loss related to equipment malfunction, ADVANTECH uses the following symbols throughout this document to indicate safety-related information.

**WARNING! This indicates a hazardous procedure that may result in serious injury or death if not performed properly.**

**CAUTION!** This indicates a hazardous procedure that may result in light-to-severe injury or loss related to equipment malfunction, if proper precautions are not taken.

For your own safety, read the following carefully **BEFORE** operating this equipment!

---------- **WARNING** ----------

When supplying power to this equipment, verify that the 3-pin power connector (**item 1, TABLE 13** at page 49) and interconnecting cable have the correct pin assignment (**TABLE 3** at page 32). Connect the cable to a properly grounded 3-pin power outlet. Also use a ground strap between the station's ground bus and the ground screw located on the mounting frame. If power is supplied without grounding the equipment, there is a risk of receiving a severe or fatal electric shock. In the context of this document any voltage that is lethal is viewed as 'High Voltage'. The prime power potential of 220 VAC applied to the equipment is known to cause injury or death.

---------- **WARNING** ----------

**The operator cannot repair this equipment**. **DO NOT attempt to remove the Block Up-Converter cover or disassemble the internal components**. Only qualified service technicians should service the Block Up-Converters. There are high-voltage parts within the Block Up-Converters, which present a risk of severe injury to the untrained personnel. In addition, there is a risk of damaging the delicate components.

---------- **WARNING** ----------

**ALWAYS TERMINATE THE OUTPUT WAVEGUIDE FLANGE OF A BLOCK UP-CONVERTER UNIT WITH AN RF LOAD CAPABLE OF DISSIPATING FULL CW RF POWER. ALSO, TERMINATE THE RF INPUT CONNECTOR TO AVOID THE POSSIBILITY OF THE UNIT BEING DRIVEN BY STRAY LEAKAGE SIGNALS.**

Incorporate the terminations prior to applying prime power to a Block Up-Converter. This procedure prevents self-oscillation and irradiation from and into the local environment. If the RF input of a Block Up-Converter is not connected to an RF source, the unit may go into a self-induced mode and generate high levels of RF energy. Destruction caused by an excessive load voltage standing wave ratio (VSWR) will void the warranty.

Although this equipment has an internal VSWR protection of greater than 3:1 and will automatically shut down (1 second delay), it is a safe procedure to avoid the unwanted effects.

---------- **WARNING** ----------

**DO NOT LOOK INTO THE RF OUTPUT PORT OF A POWERED BLOCK UP-CONVERTER!**

Handle the units with extreme care. Although the levels of microwave radiation do not induce immediate physical discomfort in most individuals, the levels may be sufficiently high to induce long-term effects. The eyes are the most vulnerable parts of the body.

The maximum permissible levels of RF exposure are quite low compared to the power levels emitted by the Block Up-Converters built by Advantech (e.g. less than 10 mW versus 10 to 500 W for the units). The permissible levels are currently being studied by a number of organizations. In the past, the U.S. Safety Code established a dosage rate of 10 $mW/cm^2$. Currently, consideration is being given to reduce the permissible level to 1 $mW/cm^2$ in the United States, as has been the case for several European countries.

---------- **CAUTION** ----------

**THE BLOCK UP-CONVERTER UNITS ARE HEAVY (50 kg /110 lb for each unit)! TWO OR MORE INDIVIDUALS OR A LIFTING DEVICE MUST BE USED TO LIFT AND MOVE THE UNITS.** There is a risk of back injury, if carried or lifted by a single person.

In addition to this Section, included by reference are the following pertinent sections of the International Standard IEC-215, 'Safety requirements for radio transmitting equipment':

Appendix D, 'GUIDANCE ON ASSESSING THE COMPETENCE OF PERSONNEL FOR DESIGNATION AS SKILLED' and also Sub-clause 3.1 of the Standard.

Appendix E, 'GUIDANCE ON SAFETY PRECAUTIONS TO BE OBSERVED BY PERSONNEL WORKING ON RADIO TRANSMITTING EQUIPMENT' and also Sub-clauses 3.2, 3.7 and 22.1 of the Standard.

# 2. GENERAL INFORMATION

The SSPBM-K100-BRE is a Ku-Band (14.00 – 14.50 GHz) 100-Watt Solid State Powered Block Up-Converter (SSPB) designed for satellite up-link communication systems. The SSPB is an outdoor unit constructed for mounting near the hub of an antenna.

For a reliable and trouble free operation, built-in monitor and control features indicate the current status of the SSPB and provide fault detection and protection when operating outside its normal operating conditions. The SSPB also allows the user access to the monitor and control functions by using a discrete interface. The RF output of a stand-alone SSPB connects to an antenna by using a WR75 waveguide system. The product outline for a single SSPB unit is shown in **Figure 1** at page 11.

The SSPB can also be used as part of a **1:1 Redundant System**. The redundant system contains two SSPB, an L-Band Splitter, a waveguide switch, the dedicated wiring harnesses and waveguides and a mounting frame. The product outline for the complete system is shown in **Figure 2** at page 12. The RF output port of both SSPB within this system connect to a waveguide switch. Depending on the status of each unit, the waveguide switch will connect the RF output port of an SSPB to either an RF absorbing load or to a waveguide system leading to an antenna.

## 2.1 ABOUT THIS MANUAL

This manual contains information that describes the installation, operation and maintenance procedures for the 100-Watt Ku-band hub-mount (outdoor) SSPB model SSPBM-K100-BRE. Because specialized training is required for some phases of installation and operation, certain parts of this manual are directed only to properly trained personnel. Warnings appear at the appropriate points to caution all users of the potential RF and high-voltage hazards.

The **SAFETY** Section contains the guidance and precaution instructions necessary to prevent accidents from occurring when working with high-voltages and an SSPB.

The **MAJOR SUBSYSTEMS AND THEIR FUNCTION** Section describes in detail how the major components function within an SSPB and in a 1:1 redundant system.

The **INTERFACES** Section lists and describes in detail the function of the three interfaces provided by the SSPB. The function of each individual line that is part of the applicable interface is also described.

The **UNPACKING AND INSTALLATION** Section provides the guidelines and instructions for the correct installation of an SSPB and the mounting frame.

The **PRE-POWER AND SYSTEM CHECKOUT** Section contains instructions of how to prepare a single SSPB or the 1:1 redundant system for start-up and to verify for the correct status.

The **OPERATION** Section describes in detail of how to start-up an SSPB for normal operation. The 1:1 redundant system operation is also described.

The **MAINTENANCE** Section contains the preventive maintenance procedures.

For a safe and versatile operation, please read carefully all of the information provided by this manual **BEFORE** using this equipment.

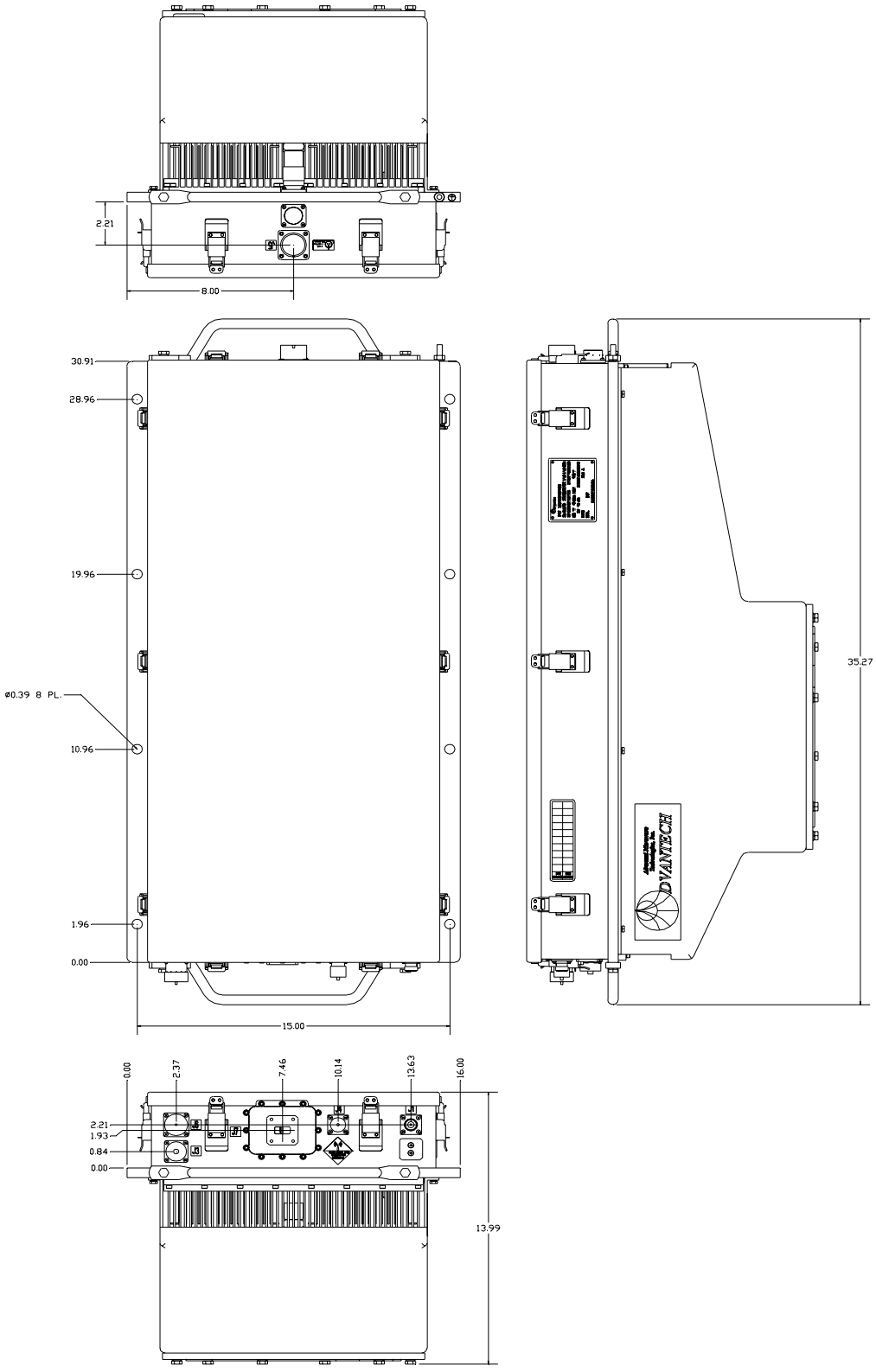


**Figure 1:** Product Outline (Single Unit)

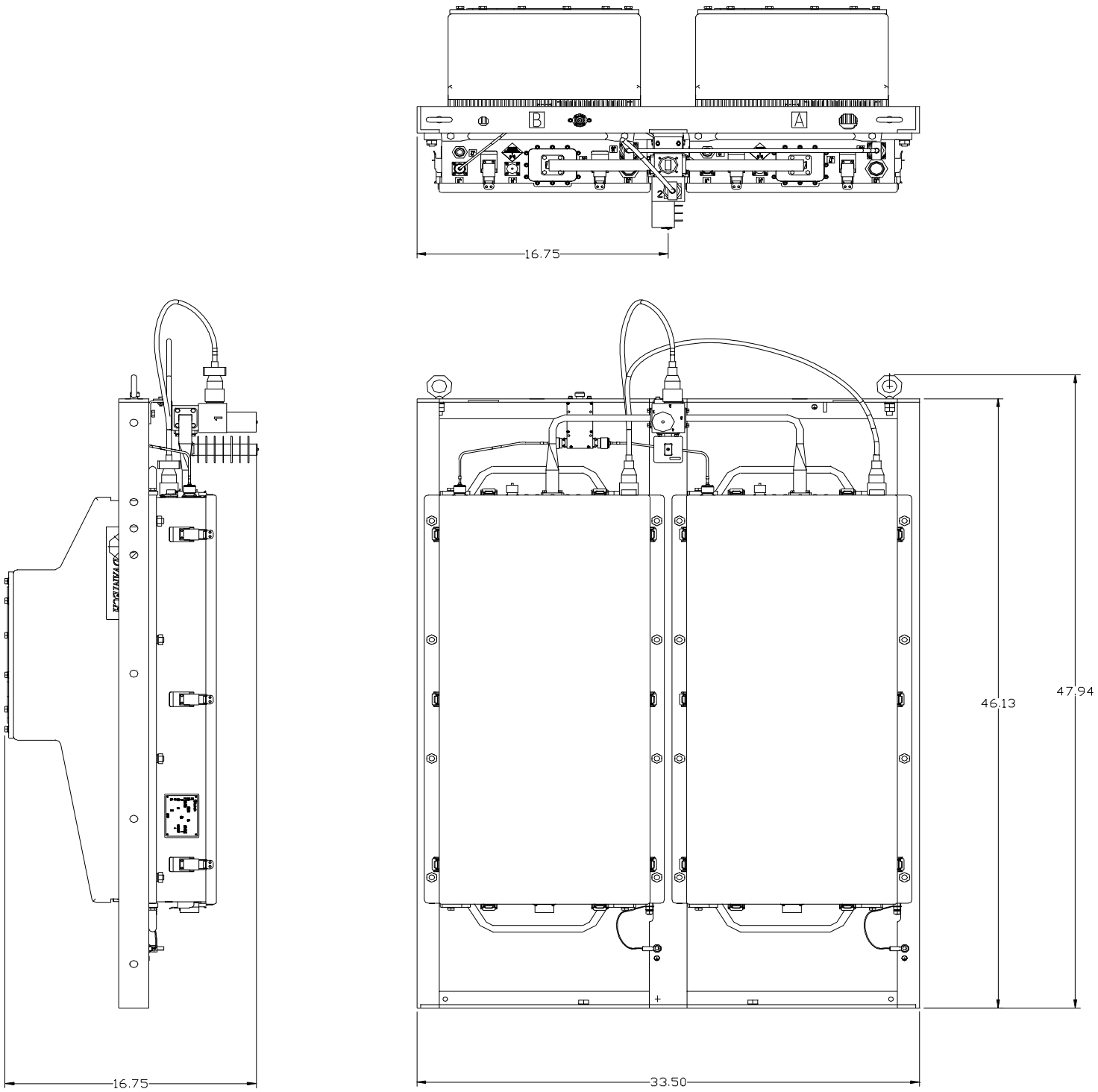


**Figure 2:** Product Outline (1:1 Redundant System with Mounting Frame)

# 3. MAJOR SUBSYSTEMS AND THEIR FUNCTION

This Section describes in detail of how the major components function within an SSPB and in a 1:1 redundant system. Each SSPB incorporates an Interface Assembly, 10 MHz Reference External/Internal Switch Assembly (not used in this application, which is set for internal reference only), Up-Converter Assembly, RF Module, Waveguide Arm Assembly, Main Controller Board, Power Supply Subsystem and a Cooling Subsystem. The remote monitoring and control of all major parameters is accessible by using the Discrete Interface. A Redundant Interface is also available for the direct communication between the two SSPBs in a 1:1 redundant system. The SSPB block diagram is shown in **Figure 3** at page 21 and **Figure 4** at page 22.

The 1:1 redundant system contains two SSPBs, which mount on to a redundancy frame and are interconnected using the dedicated harnesses, waveguides, flexible cables and the waveguide switch. The redundant system block diagram is shown in **Figure 5** at page 23.

## 3.1 INTERFACE ASSEMBLY

The L-Band RF signals enter the Interface Assembly through a semi-rigid cable and a 50 Ohm N-type connector, see **Figure 3** at page 21. The Interface Assembly has two voltage controlled variable attenuators (VVA) a Low Noise Amplifier (LNA) assembly and the Medium Power Amplifier (MPA) assembly. The two amplifier sections contain low noise, high gain GaAs FET devices that were selected in order to boost the power level of the L-Band signals by 5 to 10 dB at the output of the Interface Assembly depending on the temperature. The increase in the RF power level is necessary to drive the Up-Converter Assembly.

Integrated into the Interface Assembly are the two variable attenuator sections. The first attenuator section allows the operator to adjust the overall gain of the SSPB, which sets the RF output power level to a desired value or below saturation. The user can adjust the gain by sending the correct command remotely through the Discrete Interface using the RS232 or RS485 protocol. The Main Controller Board detects the command and produces a DC voltage, which is sent to the attenuator. The electrical characteristics of the attenuator change with the applied DC voltage, which reduces or increases the RF signal power level within the Interface Assembly.

The second attenuator section is used to maintain the gain of the Interface Assembly constant with changes in temperature (global temperature compensation). Temperature sensors from within the Driver and Power Modules send a temperature dependent DC voltage to the power conditioner board assembly within the Driver Module. The voltage is then sent to the second attenuator within the Interface Assembly. The change in the DC voltage changes the electrical characteristics of the attenuator. The second attenuator changes the RF signal power level in a similar manner as for the first attenuator.

## 3.2 10 MHz REFERENCE EXTERNAL/INTERNAL SWITCH ASSEMBLY

This circuit is used to generate a 10 MHz reference carrier that is required for the frequency up conversion of the L-Band signals within the Up-Converter Assembly. The reference signal is sent to a synthesizer within the Up-Converter Assembly via a semi-rigid cable. These units do not use the switching part of this assembly, as the reference 10 MHz signal is internally generated.

## 3.3 UP-CONVERTER ASSEMBLY

The Up-Converter Assembly amplifies and converts the incoming L-Band carrier signals into the Ku-Band carrier signals. To achieve this requirement, the module contains a synthesizer, a multiplier, a mixer, an LNA and a band-pass filter see **Figure 3** at page 21. For this type of application, the Up-Converter Assembly requires a 10 MHz reference and the L-Band signals. The L-Band signals are fed into a mixer by an input co-axial interface connector. The 10 MHz reference signal is fed into the input of a phase locked oscillator within the synthesizer.

The synthesizer consists of a phase lock loop local oscillator (PLL LO) assembly and a power conditioner board. The low phase, low noise RF oscillator is normally phase-locked with the incoming 10 MHz reference. The RF oscillator is a dual-loop configuration type consisting of two voltage-controlled oscillators and the associated circuitry to produce the required 2.175 GHz signal.

When the phase lock loop local oscillator is functioning correctly, the oscillator sends the 2.175 GHz carrier to a multiplier. The multiplier then produces an intermediate frequency of 13.050 GHz, which is sent to the second input of the mixer.

The synthesizer also contains an out of lock protection circuitry that prevents the carrier frequency of the Ku Band signals from shifting. When the oscillator is not phase locked with the 10 MHz reference, a TTL voltage is sent to the power conditioner boards within the Driver and Power Modules to disable the RF devices. A FAULT signal is also sent from the Main Controller Board to the user's monitor and control system through the Discrete Interface. For a 1:1 redundant system, the Main Controller Board will also send a FAULT signal to the standby SSPB. A similar situation arises if the 10 MHz reference signal is not present at the synthesizer input.

At the output of the mixer, a band-pass filter selects the appropriate up-converted Ku-Band signals. These signals are then sent through an isolator and the semi-rigid cable with connectors to drive the RF Module. The isolator removes the presence of unwanted reflected signals, which may reduce the efficiency of sending the desired Ku-Band signals through the Up-Converter Assembly.

## 3.4 RF MODULE

Each SSPB contains an RF Module operating over the frequency range of 14.00 to 14.50 GHz. This module contains the Driver Module, Driver/Power Waveguide Assembly and the Power Module.

### 3.4.1 DRIVER MODULE

The RF signals enter an RF input isolator within the Driver Module by a semi-rigid cable see **Figure 4** at page 22. The isolator provides a minimum Input Return Loss of 18 dB and a VSWR protection of approximately 1.3 to 1 over the entire frequency band. The isolator reduces or eliminates unwanted reflected signals that may propagate through the transmission path of the desired Ku-Band signals. Following the isolator is a variable attenuation section and a low power amplifier (LPA) operating over the frequency range of 14.00 to 14.50 GHz. For this unit the attenuator is set to a fixed value at the factory.

Following the LPA assembly is a second attenuator section that maintains the gain of the Driver Module constant with changes in temperature. A temperature sensor within the High Power Amplifier (HPA) assembly sends a DC voltage proportional with temperature to the power conditioner board assembly within the module. The voltage is then sent to a pin diode within the attenuator that changes the RF signal power level.

To achieve a gain of 50 dB, the Driver Module contains low-noise high gain GaAs FET devices within the LPA and HPA assembly. Isolators are inserted within the LPA and HPA assemblies to reduce or eliminate unwanted reflected signals. These devices improve the efficiency of sending the desired RF signal through the two assemblies.

The Driver Module also has a power conditioner board assembly (see **Figure 4** at page 22) that consists of the bias, control and protection circuitry. This circuitry has the following functions:

1. Provides and removes the DC voltages to the GaAs FET devices within the module.
2. Provides a temperature dependent DC voltage to the second attenuator within the module and to the Interface Assembly.
3. Sends an alarm signal to the Main Controller Board when detecting a fault or over temperature.

The power conditioner board assembly will remove the DC voltages to the GaAs FET devices when any of the following occurs:

1. The user sends a MUTE command through the Discrete Interface.
2. The ambient temperature exceeds 80°C,
3. Any of the GaAs FET devices fails or
4. Out-of-Lock signal sent from the Up-Converter Assembly.

The Driver Module is integrated on a heat sink and provides an interface for the monitor and control signals. Following the Driver Module, the RF signal enters the Driver/Power Waveguide Assembly.

### 3.4.2 DRIVER/POWER WAVEGUIDE ASSEMBLY

The Driver/Power Waveguide Assembly splits the RF output signal from the Driver Module into two RF signals for the two RF input ports of the Power Module see **Figure 4** at page 22. The signal power level for each RF input signal is 3 dB lower than the RF output signal from the Driver Module. The Driver/Power Waveguide Assembly serves as a waveguide to coaxial transition for the proper impedance matching between the Driver and Power Modules.

### 3.4.3 POWER MODULE

To achieve the RF output power level of 100 Watts, this module contains two amplifier sections that are internally matched and operate in parallel see **Figure 4** at page 22. Each section contains seven low noise, high power GaAs FET devices, which can increase the RF signal power level up by approximately 46 dBm. The output of each channel are then combined together to achieve the required power level of 49 dBm. The Power Module is designed boost the power level of the Ku-Band signal by approximately 10 dB.

The Power Module also has a power conditioner board assembly, which functions similarly as for the Driver Module.

Temperature sensors are installed at the module's hot spots to protect the RF devices from overheating and operating at temperatures exceeding 80ºC.

The Power Module is integrated on a heat sink and provides an interface for the monitor and control signals.

## 3.5 OUTPUT WAVEGUIDE ARM ASSEMBLY

The Output Waveguide Arm Assembly of each SSPB includes a band-pass harmonic filter, a RF coupling port (for output power monitoring), two detectors and an RF output circulator see **Figure 4** at page 22. The band-pass harmonic filter provides a minimum attenuation of 65 dB for all of the unwanted harmonic frequencies other than the fundamental Ku-Band signals.

The RF output monitor port samples the RF output signal and is calibrated in terms of the coupling ratio versus the frequency. This port permits the independent monitoring of the SSPB output power levels through an N-type connector. A spectrum analyzer or a portable power meter can be used to monitor the RF output power level.

The forward and reverse power detectors provide the user the forward and reverse RF power levels within the output waveguide arm assembly through the Discrete Interface. The forward power detector sends a DC voltage proportional with the forward RF signal strength to the micro-controller within the Digital Power Monitor. A signal in RS485 format is then sent to the Main Controller Board.

The reverse power detector also sends a DC voltage proportional with the reverse RF signal strength to the Main Controller Board.

The controller within the Main Controller Board detects the signals and sends the information to the user in RS485 and RS232 protocol. The modem/personal computer decodes the signals and displays the RF forward output and RF reverse power levels. An alarm signal is sent to the user if the reverse power exceeds its threshold value or if the forward power is less than its threshold value.

The circulator provides a VSWR protection of 1.3:1 at the RF output port. The return loss at the circulator output is 20-dB minimum. The circulator functions similarly to the isolators used in the RF Module accept that it is capable of handling the high RF output power level. A grooved output waveguide flange type WR-75 terminates the circulator output.

## 3.6 MAIN CONTROLLER BOARD

All of the controls, input/output communication and the decision-making, with the exception of the critical module-level decision are performed by the micro-controller within the Main Controller Board. The Main Controller Board provides:

1. Fault detection and indication (discrete pins A and B; serial communication through pins E, L and M of the Discrete Interface)
2. Remote enable/disable control (discrete pins C and D of the Discrete Interface)
3. Over threshold reverse RF power indication (serial communication through pins L and M of the Discrete Interface)
4. Under threshold forward RF power indication (serial communication through pins L and M of the Discrete Interface)
5. Redundancy control (Redundant Interface; serial communication through pins F, J and K of the Discrete Interface).

The micro-controller within the Main Controller Board ensures that the SSPB is functioning correctly. To satisfy this requirement, the micro-controller communicates with the following:

1. Power conditioner board within the Power Module
2. Power conditioner board within the Driver Module
3. Micro-controller within the Digital Power Monitor
4. Power conditioner board and synthesiser within the Up-Converter Assembly

The micro-controller also communicates with the following:

1. User's monitor and control system.
2. Main Controller Board within the second SSPB as part of the 1:1 redundant system.

### 3.6.1 FAULT DETECTION AND INDICATION

When a fault occurs within the SSPB, the power conditioner board (Driver or Power Module) sends a FAULT signal to the controller within the Main Controller Board. The controller causes the FAULT relay within the Main Controller Board to de-energize (FAULT-NO contact not connected to the common terminal). The relay then sends a discrete FAULT signal through pins 'A' and 'B' of the Discrete Interface to the user's remote system interface indicating the FAULT condition. The controller also sends an encoded RS232/RS485 FAULT message through pins 'E', 'L' and 'M' of the Discrete Interface.

The controller within the Main Controller Board will send a FAULT signal to the user when any one of the following occurs:

1. Phase lock loop local oscillator within the synthesiser is out of lock.
2. The baseplate temperature exceeds 80°C,
3. Any of the GaAs FET devices fails, or
4. +12VDC high current drawn from the main power supply exceeds 150 A.

Each SSPB continually monitors the internal temperature and the current consumption. It also has an automatic shutdown feature to prevent operation at excessive temperatures. An ALARM will be triggered when the internal temperature of the SSPB exceeds 70°C. The SSPB will continue to operate in this condition.

The SSPB will automatically restart when its internal temperature decreases to 65°C. A thermal alarm may result from any one of the following conditions:

1. High ambient temperature (SSPB is designed to operate between -30°C and +60°C ambient).
2. Blockage at the air intake or exhaust.
3. Worn fan

### 3.6.2 MUTE CONTROL

The user may MUTE the RF circuits within the Driver and Power Modules remotely by:

1. Disconnecting pin C (Mute In) from pin D (common) of the Discrete Interface connector (J3).
2. Sending the Mute command in RS232/RS485 format through the Discrete Interface at pins E, J and K.

The controller within the Main Controller Board responds to the MUTE/ENABLE command by sending an internal (OUT-OF-LOCK) signal to the power conditioner boards within the Driver and Power Modules. The power conditioner boards then send a DC voltage to enable/disable the GaAs FET devices. This feature is useful if the user wishes to perform a maintenance check or to check out the transmission system.

## 3.7 MAIN POWER SUPPLY

The Main Power Supply of each unit consists of two identical, 1500 W power supply modules. Each module can supply the following outputs:

- 3 x 25 A @ + 12 VDC,
- 3 x 0.1 A @ - 9 VDC,
- 0.1 A @ +15 VDC

The power supply portion of the SSPB provides all of the internal voltages necessary to operate the RF Module and the Main Controller Board. Both power supply modules and the cooling fan are configured for 220 VAC operation. The overall power consumption at the rated RF output power is typically 1400 Watt. The power supply system has no power factor correction.

## 3.8 COOLING SUBSYSTEM

The cooling subsystem of each unit includes the fan and the wiring harness provided for easy fan replacement. The cooling fan is configured for 220 VAC operation and is under the control of a thermal switch. To minimise the power consumption of the cooling fan at different temperatures, a temperature dependent DC voltage is sent from the Power Module to the speed control board, see **Figure 4** at page 22. This circuit responds by producing a signal consisting of pulses that vary in width depending on the temperature. The signal is then sent to the Cooling Subsystem fan. By changing the pulse width of the signal, the speed of the fan varies.

## 3.9 WAVEGUIDE SWITCH ASSEMBLY (1:1 REDUNDANT SYSTEM)

The Waveguide Switch Assembly consists of four waveguide ports. For the 1:1 redundant system, the Waveguide Switch Assembly normally connects the RF output port of the on-line SSPB ‘A’ to an antenna waveguide system while the standby SSPB ‘B’ connects to an RF absorbing dummy load see **Figure 5** at page 23.

The Waveguide Switch Assembly can be set into one of two positions. To select either position, the Waveguide Switch Assembly contains two relay coils. To set the switch to position ‘1’, a DC voltage must be applied to the coil, which is designed to set the waveguide switch to that position (i.e. one coil is used to set the waveguide switch to position 1, while the other coil is for position 2). For this system, a voltage of +12 VDC is used to excite the waveguide switch coils. The working SSPB will provide a return for the +12 VDC voltage if the other unit becomes defective. The result is a +12 VDC voltage drop across the coil connected to the working SSPB. The coil then causes the waveguide switch to connect the RF output of the working SSPB to the waveguide system leading to an antenna while the RF output of the failed unit connects to the RF absorbing dummy load. Switching will not take place if both SSPBs are defective.

The Waveguide Switch Assembly also has relay contacts that are used to provide the status information between the two SSPBs. The relay coils and contacts are accessible through a 19-pin circular connector that provides the correct interface for the Redundant Interface cable.

## 3.10 MOUNTING FRAME ASSEMBLY (1:1 REDUNDANT SYSTEM)

The Mounting Frame Assembly (see **Figure 2** at page 12) consists of a metallic structure designed to withstand the entire system and confers to the strength and stability requirements for outdoor applications.

## 3.11 INTERCONNECTING CABLES AND HARNESSES

The Interconnecting Cables and Harnesses provide the communication links between the two SSPB micro-controllers, between the SSPB and the waveguide switch assembly and between the SSPB(s) and the operator's remote communication system through the Discrete Interface port.

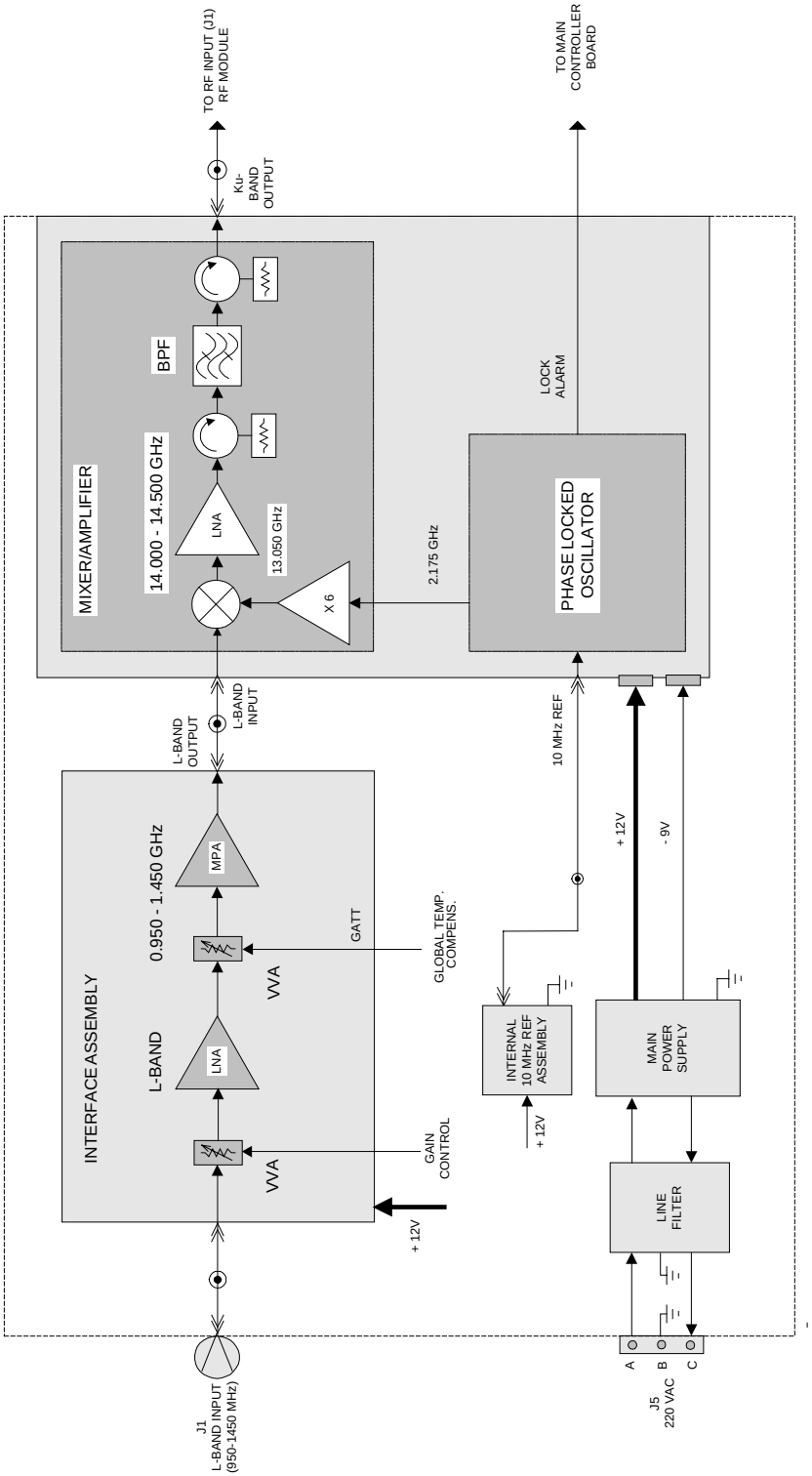


**Figure 3:** Up-Converter Section Block Diagram

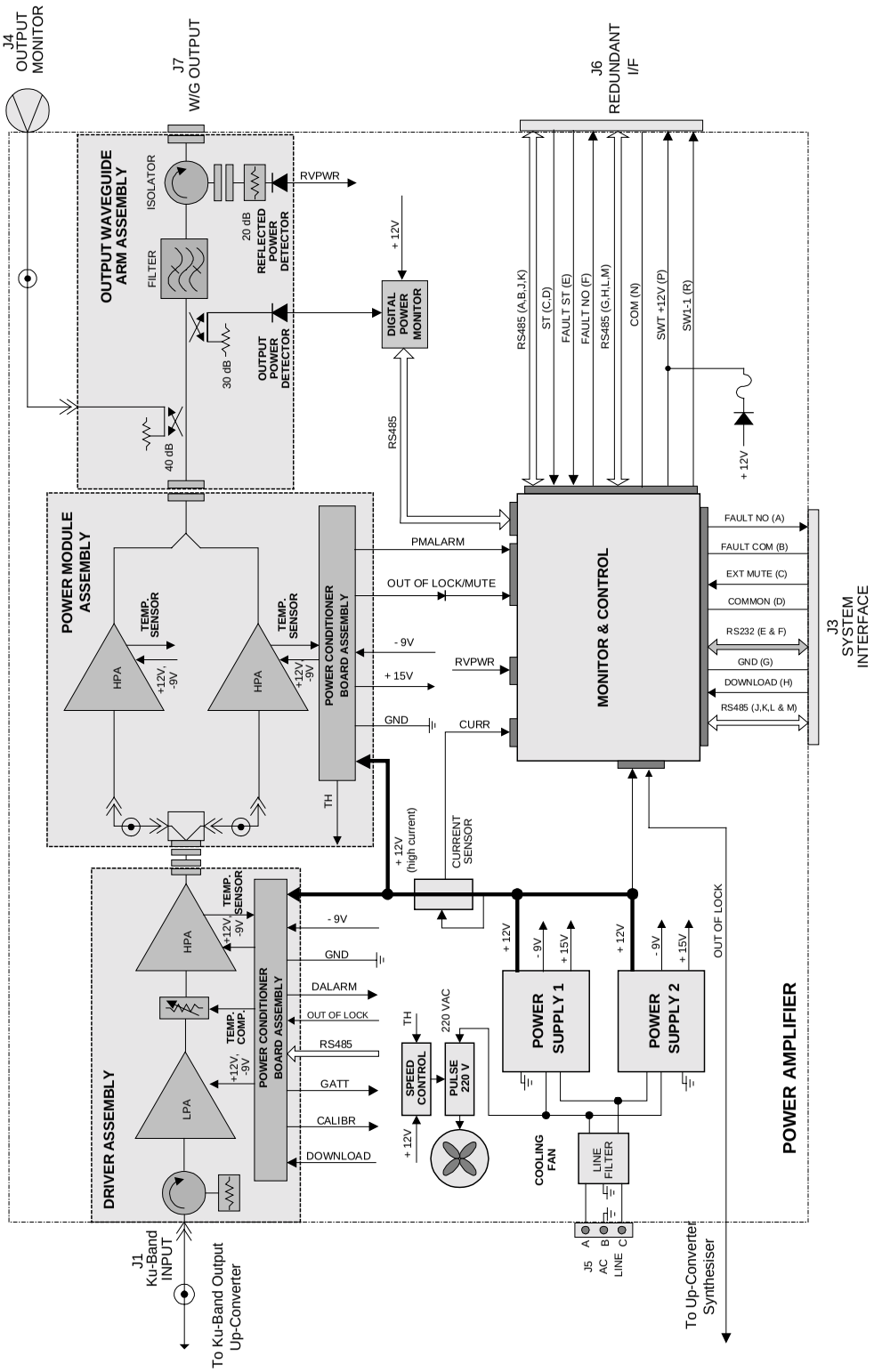


**Figure 4:** Power Amplifier Section Block Diagram

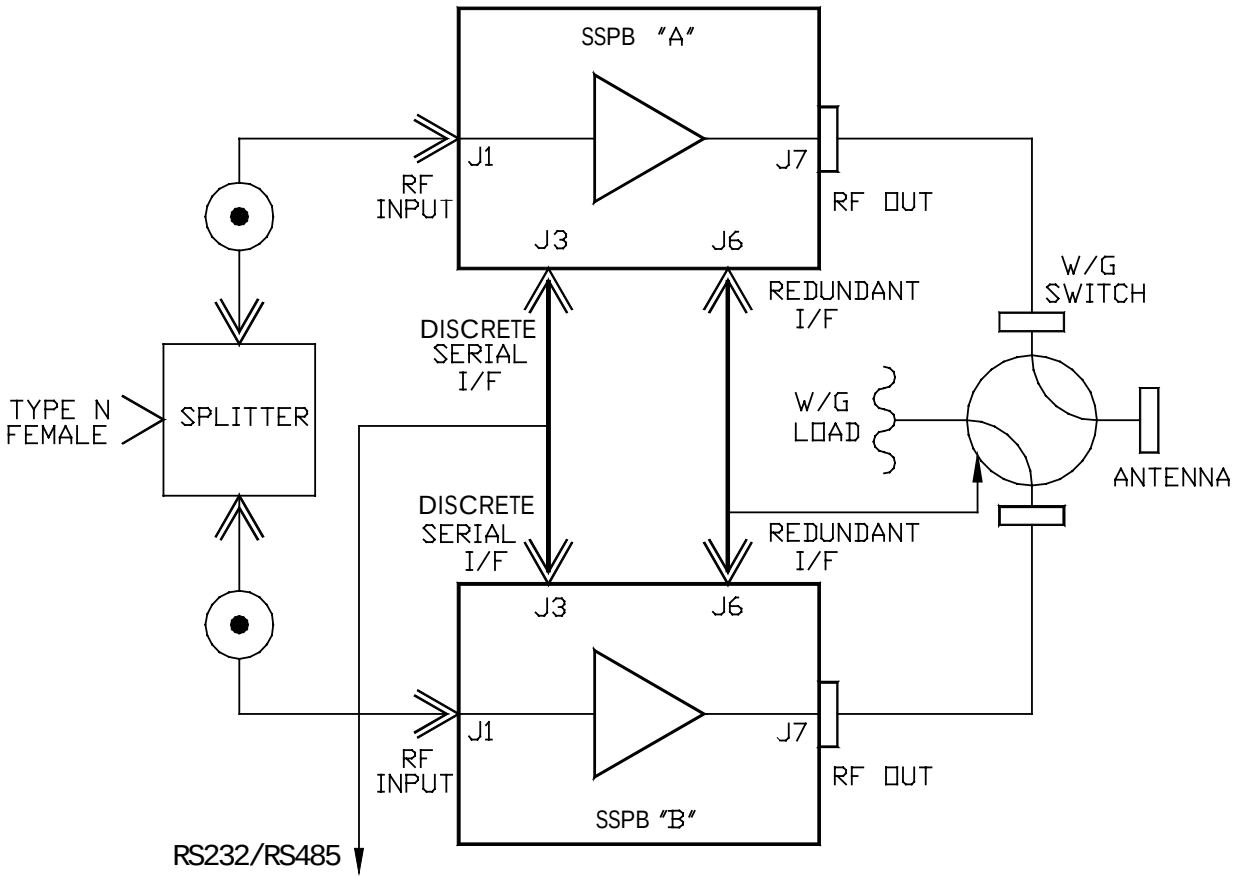


**Figure 5:** 1:1 Redundant System Block Diagram

# 4. INTERFACES

Each SSPB provides three interfaces that can be used to connect it to several optional external devices. The interfaces for this model (SSPBM-K100-BRE) are listed below:

1. **Discrete Interface (J3):** This interface offers the complete monitoring and control of the SSPB by the discrete signal and the remote serial communication in accordance with a command or status request.
2. **RF Output Monitor Interface (J4):** This interface provides a measure of the output power of the unit.
3. **Redundant Interface (J6):** This interface provides the communication between the two SSPBs and control over the waveguide switch assembly.

## 4.1 DISCRETE INTERFACE

The Discrete Interface is located at connector (J3) of the SSPB. This connector is a 12-pin MS3112E14-12P (male) connector with a pin assignment as shown in **TABLE 1** at page 25. This interface has discrete, RS232 and RS485 serial communication with the user's remote communication system.

Pins A and B of connector (J3) are of Form-C relay type outputs that provide the user an indication informing the status of the SSPB. If pin A is open relative to pin B, a FAULT state signal is sent to the user. If pin A is in contact with pin B, the resulting signal is sent to the user informing that the unit is functioning correctly.

Pins C and D of connector (J3) are the opto-isolator inputs, allowing the user to mute or enable the RF circuits within the SSPB. If the user connects pin C to pin D (common), the SSPB unit will be enabled (RF circuits functioning). If the user disconnects pin C from pin D (common), the RF circuits will disable (RF OFF).

**NOTE:** If pin C is not connected to pin D, then the SSPB cannot become RF enabled by using the RS232/RS485 serial communication or reapplying power.

Pins E and F of connector (J3) (RS232 Tx and RS232 Rx respectively) are used to adjust the gain of the SSPB for temperature compensation in serial communication format (performed only at the manufacturer's site). This interface may also be used to monitor and control the SSPB with an IBM® compatible personal computer (PC) running in DOS 3.1 or higher.

Pins G (ground) and H (Download) are used for the downloading of software provided by the manufacturer (performed only at the manufacturer's site).

Pins J (RS485 Rx-L), K (RS485Rx-H), L (RS485 Tx-L) and M (RS485 TX-H) of connector (J3) is a serial communication interface that allows for the external monitoring and control of the SSPB.

A standard SPL-ACT (SL2048 Modem) with RS485 (4-wire) communication software or an IBM® compatible personal computer (running DOS 3.1 or higher) with an RS232/RS485 adapter may be used for this interface.

The user must fabricate the interconnecting cable(s) for this interface. The correct connector type is provided in the shipping kit (see **TABLE 13** at page 49, **item 2**). The Discrete Interface for each SSPB can be connected together in parallel.

**TABLE 1:** DISCRETE INTERFACE (J3) – PIN ASSIGNMENT

| Pin | Description | |
|---|---|---|
| A | Amplifier FAULT<br>If open relative to pin B: FAULT state<br>If closed to pin B: NO FAULT | |
| B | Amplifier FAULT Common | |
| C | External MUTE Command<br>If pin C is not connected to pin D (common), the SSPB is disabled (MUTE state).<br>If pin C connects to pin D (common), the RF circuits are enabled. (RF ON) | |
| D | Common | |
| E | RS232 Tx | This serial interface is used to adjust the gain for the temperature compensation and is performed only at the manufacturer's site. The RS232 interface may be also used to monitor and control the SSPB by using a computer terminal loaded with the proper communication software such as the Term95 or HyperTerminal. |
| F | RS232 Rx | |
| G | GND | |
| H | DOWNLOAD | |
| J | RS485Rx-L | This serial interface allows for the external monitoring and control of an SSPB, using a standard SPL-ACT (SL2048 Modem) and RS485 (4-wire) communication software or a PC with an RS232/RS485 adapter. |
| K | RS485Rx-H | |
| L | RS485Tx-L | |
| M | RS485Tx-H | |

## 4.2 RF OUTPUT MONITOR PORT

This RF interface is located at the (J4) connector of the SSPB. It is used for the independent monitoring of SSPB output power level through the use of an external power meter. To determine the true output power in dBm, add to the value measured at the RF Output Monitor Port (J4), the calibrated coupling factor corresponding to the specific frequency. A table of the coupling factor versus the frequency can be found in the Test Data Sheets provided with each SSPB.

### 4.3 REDUNDANT INTERFACE

This interface enables the communication between the two SSPB micro-controllers and provides control over the waveguide switch. The Redundant Interface connections are made with connector (J6) of each SSPB. This connector is a 26-pin MS3112E16-26P (male) connector with a pin assignment as shown in **TABLE 2** below. A redundancy cable with connectors is provided in the redundancy kit see **item 5, TABLE 14** at page 50. For a standalone SSPB, this interface is not used. The interconnections for the 1:1 redundant system are shown in **Figure 5** at page 23.

**TABLE 2:** REDUNDANT INTERFACE (J6) - PIN ASSIGNMENT

| Pin # | Signal | Type | Description |
|---|---|---|---|
| A | RS485Tx-H1 | Transmit high level logic | Serial Interface communication between the SSPB micro-controller and the customer's supervisory and control system. |
| B | RS485Tx-L1 | Transmit low level logic | Serial Interface communication between the SSPB micro-controller and the customer's supervisory and control system. |
| C | ST1-1 | Input - Relay contact | Closed contact to ground informs the SSPB micro-controller that the other SSPB is connected to an antenna. |
| D | ST1-2 | Input - Relay contact | Open contact informs the SSPB micro-controller that the other SSPB is connected to an antenna. |
| E | FAULT-ST | Input - normally open | Open contact of other SSPB indicates that it is at FAULT. |
| F | FAULT-NO | Output - normally open contact | Open contact of FAULT Form-C relay indicates a fault is within this SSPB. |
| G | RS485Tx-L2 | Transmit low level logic | Serial Interface communication between the two SSPB micro-controllers. |
| H | RS485Tx-H2 | Transmit high level logic | Serial Interface communication between the two SSPB micro-controllers. |
| J | RS485Rx-L1 | Receive low level logic | Serial Interface communication between the SSPB micro-controller and the customer's supervisory and control system. |
| K | RS485Rx-H1 | Receive high level logic | Serial Interface communication between the SSPB micro-controller and the customer's supervisory and control system |
| L | RS485Rx-H2 | Receive high level logic | Serial Interface communication between the two SSPB micro-controllers. |
| M | RS485Rx-L2 | Receive low level logic | Serial Interface communication between the two SSPB micro-controllers. |
| N | COM | System common | Common contact of Form-C relay. |
| P | SWT+12V | Voltage Source | Relay coil common terminal connected to +12 VDC supply through a steering diode. |
| R | SW1-1 | Output - momentarily low | Closure to +12 VDC return; waveguide switch position is set to connect this SSPB output to an antenna system. |

# 5. UNPACKING AND INSTALLATION

This Section contains the instructions for the site preparation, unpacking and the installation of a single SSPB and the 1:1 redundant system for model SSPBM-K100-BRE.

## 5.1 INITIAL INSPECTION

Inspect the shipping container(s) for any damage suffered during the shipment. If damaged, immediately contact the carrier that delivered the equipment and submit a damage report. Failure to do so may invalidate future claims.

## 5.2 UNPACKING

**CAUTION!** Each SSPB unit weighs 50 kg (110 lb). Use a lifting device when handling and moving this equipment. There is a risk of back injury if a single person attempts to lift and carry this equipment.

Carefully remove all of the items from the shipping container(s). Save all of the packing material until completing the visual inspection successfully. For a standalone unit, verify that all of the items listed in **TABLE 13** at pages 49 are present. For the 1:1 redundant system, verify that all of the items listed in **TABLES 13 through 15** at pages 49 through 51 are present. If any of the items listed are missing, immediately contact ADVANTECH. Inspect all of the items for evidence of damage suffered during the shipment. If damage seems evident, immediately contact the carrier that delivered the equipment and file a claim. Failure to do so may invalidate future claims. Check the SSPB(s) thoroughly for damaged or loose parts.

## 5.3 INSTALLATION

Installation of a single SSPB or the 1:1 redundant system requires the following five procedures:

- Discrete Interface and DC Power interconnecting cable construction
- Environmental and adequate ventilation considerations
- Mechanical installation
- RF connections
- Electrical connections

### 5.3.1 DISCRETE INTERFACE AND DC POWER CABLE CONSTRUCTION

Prior to constructing the interconnecting cables, verify that the cables are of sufficient length in order to connect the SSPB(s) to the user's remote monitor and control system. Construct the Discrete Interface and Power interconnecting cables as follows:

1. Construct the Discrete Interface cable(s) using the mating connector provided in the shipping kit (see **TABLE 13**, at page 49, **item 2**) and refer to **TABLE 1** at page 25 for the correct pin assignment.

**NOTE:** When attaching a suitable connector to the remaining end of a Discrete Interface cable, refer to **Section 7.4.1** at page 36 for the correct connector type and pin assignment for the RS232 and RS485 serial communication.

2. Construct the prime power cable(s) using the connector(s) provided in the shipping kit (**item 1, TABLE 13** at page 49). For the correct pin assignment refer to **TABLE 3** at page 32.

### 5.3.2 ENVIRONMENTAL AND ADEQUATE VENTILATION CONSIDERATIONS

Each SSPB contains a forced-air cooling subsystem that prevents the internal components from overheating and to optimize the performance stability. The cooling subsystem consists of a variable speed fan to effectively distribute and remove the air from within the SSPB.

Prior to installing a single SSPB or the 1:1 redundant system, verify that:

1. Environmental conditions listed in **TABLE 4** at page 32 will be met.
2. A minimum clearance of 30-cm (12 inches) is necessary below the 1:1 redundant system.
3. A minimum clearance of 30-cm (12 inches) is necessary in front of the air intake and exhaust openings for each SSPB.
4. The grill of the fan intake and the exhaust openings of each SSPB are free of any obstructing debris. Obstructing debris may reduce the efficiency of the cooling subsystem and significantly impact the SSPB longevity.

### 5.3.3 MECHANICAL INSTALLATION

**CAUTION!** The SSPB unit weighs 50 kg (110 lb). Use a lifting device or the assistance of another individual, when handling and moving this equipment. There is a risk of back injury if a single person attempts to lift and carry this equipment**.**

**Single Unit**

1. Mount the SSPB on to an antenna hub by using the eight mounting holes provided by the SSPB housing, see **Figure 1** at page 11. Use the proper hardware as described in the SSPB mounting frame kit (**TABLE 15** at page 51, **items 2 through 5**).
2. Proceed to **Section 5.3.4**.

**SSPB Installation on to the Mounting Frame (1:1 Redundant System)**

**NOTE:** In a 1:1 redundant system, the two SSPB are identical and therefore can be installed in any order on the mounting frame. However, an SSPB is assigned either an 'A' or 'B' designation as marked on the mounting frame after performing the installation. SSPB 'A' is the on-line Solid State Power Block Up-Converter that carries the communication traffic for channel A. SSPB 'B' is the standby unit that serves as a back up for the on-line unit.

1. Install two 100-watt SSPB on to the four stand-offs and the twelve holes provided by the vertical-mounting frame using the hardware listed in the SSPB mounting frame kit (**items 2, 3, 4 and 5, TABLE 15** at page 51).
2. Position the two SSPB with the mounting frame on to a flat surface with the air intakes facing downward.

**NOTE:** When viewing from the front side, the unit labelled 'A' is on the right and the unit labelled 'B' is on the left.

**Waveguide Switch Assembly Installation (1:1 Redundant System)**

To install the Waveguide Switch Assembly, proceed as follows:

1. Attach the bracket (**item 8, TABLE 14** at page 50) on to the top centre of the vertical-mounting frame using two #1/4-20 x 1/2 inch bolts and two #1/4 lock washers (**items 12 and 18, TABLE 14** at page 50).
2. Attach the switch bracket (**item 7, TABLE 14** at page 50) on to the Waveguide Switch Assembly using four #8-32 x 1/2 inch screws and four #8 lock washers (**items 17 and 22, TABLE 14** at page 50).
3. Position the Waveguide Switch Assembly as shown in **Figure 2** at page 12, aligning the waveguide arm labelled 'TO SSPB A' with the RF output port of Up-Converter 'A' and the waveguide arm labelled 'TO SSPB B' with the RF output port of Up-Converter 'B'.
4. Install a supplied waterproof gasket (**item 23, TABLE 14** at page 50) on to the RF output waveguide flanges of each SSPB.
5. After alignment verification, loosely attach the waveguide arm on to the RF output waveguide flanges of each SSPB using the hardware supplied from the redundancy kit (**items 16 and 20**, **TABLE 14** at page 50).
6. Carefully tighten all of the bolts (in opposite pairs rather than sequentially around the perimeter of the flange) so that the connection is firm.

**CAUTION!** Over-tightening the bolts may cause the stripping of the threads or distort the mating flange.

7. Attach and secure the switch bracket with the waveguide switch assembly on to the bracket by using two #8-32 x 1/2 screws and two #8 lock washers and two #8-32 nuts (**items 14, 17 and 22, TABLE 14** at page 50).

| | |
|---|---|
| **CAUTION:** | If the waveguide system is intended to be pressurised, then it is mandatory to use a pressure window at the antenna port of waveguide switch. |

**L-Band Splitter (1:1 Redundant System)**

1. Using the hardware provided in the redundancy kit (**items 15, 20 and 21**, **TABLE 14** at page 50), attach the L-Band Splitter on to the top left section of the vertical-mounting frame (two mounting holes are provided).

**NOTE:** The RF input of the splitter must face downward.

2. Connect the semi-rigid cable (**item 3, TABLE 14** at page 50) on to the RF output connector of the L-Band Splitter (port facing SSPB 'A') and the RF input port (J1) of SSPB 'A'.
3. Connect the second semi-rigid cable (**item 4, TABLE 14** at page 50) on to the RF output connector of the L-Band Splitter (port facing SSPB 'B') and the RF input port (J1) of SSPB 'B'.

**Mounting the Redundant System on to a Supporting Structure**

1. Orient the 1:1 redundant system in the upright position (RF output of Waveguide Switch Assembly should face antenna).
2. Using the sixteen holes that are provided on the base frame, bolt down this assembly on to a supporting structure.

**NOTE:** Proper mounting of this assembly is necessary in order to reduce the vibrations due to the wind and the cooling fans as well as for safety reasons.

### 5.3.4 RF CONNECTIONS

| | |
|---|---|
| **CAUTION!** | Beware of the destructive pin depth of the mating connector. When installing an RF mating connector with a destructive pin depth into an RF component connector, damage may occur to the RF component connector. A destructive pin depth is a connector having a pin length that is too long in respect to the reference plane of the connector. The centre pins of the connectors used by ADVANTECH have a precision tolerance measured in mils (1/1000 inch). The mating connectors provided by the various suppliers may not be of the precision types. Consequently, the centre pins of these devices may not have the proper depth. |

**Single Unit**

1. Connect the RF input source to the N-type connector for the RF input port (J1) of the SSPB.
2. Position the interconnecting waveguide system flange so that it aligns precisely with the waveguide flange of the SSPB RF output port (J7).
3. Install the supplied waterproof gasket (**item 6, TABLE 13** at page 49) on to the RF output port waveguide flange.
4. After alignment verification, loosely attach the interconnecting waveguide on to the RF output port using the hardware provided in the shipping kit (**items 4 and 5**, **TABLE 13** at page 49).

5. Carefully tighten all of the bolts (in opposite pairs rather than sequentially around the perimeter of the flange) so that the connection is firm.

**CAUTION!** Over-tightening the bolts may cause the stripping of the threads or distort the mating flange**.**

**1:1 Redundant System**

1. Connect the RF source on to the RF input N-type connector of the L-Band Splitter.
2. Position the interconnecting waveguide system flange so that it aligns precisely with the RF output waveguide flange of the waveguide switch assembly.
3. Install the supplied waterproof gasket (**item 6, TABLE 13** at page 49) on to the RF output waveguide flange of the Waveguide Switch Assembly.
4. After alignment verification, loosely attach the interconnecting waveguide system flange on to the RF output port using the hardware provided in the SSPB shipping kit (**items 4 and 5**, **TABLE 13** at page 49).
5. Carefully tighten all of the bolts (in opposite pairs rather than sequentially around the perimeter of the flange) so that the connection is firm.

### 5.3.5 ELECTRICAL CONNECTIONS

The connector locations referred to in this Section are shown in **Figure 6** at page 33. Electrical interconnections consist of prime power (J5), the external connections for the Discrete Interface (J3), and for the 1:1 redundant system, the Redundant Interface (J6).

Perform the electrical connection installation as follows:

1. Verify that the Discrete Interface interconnecting cable(s) was/were fabricated in accordance with **Section 5.3.1** at page 27.

**NOTE:** In a 1:1 redundant system, the Discrete Interface connections for both SSPB are the same. The discrete portion of this interface (FAULT and MUTE) can be connected together in parallel. For the serial communication portion (RS232 or RS485), either SSPB or both can be used to communicate with the user's remote monitor and control system.

2. Connect the Discrete Interface cable to port (J3) of the SSPB(s).
3. Connect the discrete portion (pins A, B, C and D) of the remaining end of the interconnecting cable to the user's remote supervisory control system.

**CAUTION!** There are internal settings in the Redundant Interface cable that define each unit based on its position on the frame. Connect the cable according to the labels provided**.**

4. For the 1:1 redundant system, connect the Redundant Interface cable with connector (**item 5, TABLE 14** at page 50) labelled 'TO SSPB A' to the Redundant Interface connector (J6) of SSPB 'A'.
5. Connect the Redundant Interface cable with connector labelled 'TO SSPB B' to the Redundant Interface connector (J6) of SSPB 'B'.
6. Attach the remaining connector of the Redundant Interface cable on to the 19-pin circular connector provided by the Waveguide Switch Assembly.
7. For grounding a single SSPB, attach a #6 gauge copper wire on to the ground terminal provided by the SSPB housing and a properly grounded structure.
8. For grounding the 1:1 redundant system, using the two safety ground cables and the hardware provided in the redundancy kit (**items 2, 13, 18 and 19, TABLE 14** at page 50).
9. Verify that AC power source is switched OFF.

**WARNING! Proper grounding of the AC power outlet is necessary for personnel and equipment safety.**

**CAUTION!** Ensure that the proper pin is selected for the 220 VAC operation. Applying power on the wrong pin will cause damage to the SSPB(s) necessitating factory repair. Refer to **TABLE 3** below for the correct pin assignment.

10. Verify that the AC power cable for the SSPB(s) was/were fabricated in accordance with **Section 5.3.1** at page 27.
11. Connect the AC power cable to the connector (J5) of each SSPB and the AC power source.

**TABLE 3:** AC LINE (J5) – PIN ASSIGNMENT (single unit)

| Pin | Description |
|---|---|
| A | LINE 1 (220 VAC between pins A & C) |
| B | GROUND |
| C | LINE 2 |

**TABLE 4:** ENVIRONMENTAL CONDITIONS

| | |
|---|---|
| Temperature:<br>Non operating (continuous exposure)<br>Operating (ambient) | <br>- 50°C to + 85°C<br>- 30°C to + 60°C |
| Relative humidity | 100 % Non Condensing |
| Altitude | 10,000 feet AMSL, de-rated 2ºC/1,000 feet from AMSL |

| **TABLE 5:** CONNECTORS DESCRIPTION | | | |
|---|---|---|---|
| **Connector** | **Function** | **Description** | **Mating Connector** |
| (J1) | Up-Converter Input | N - Type (F) | N - Type (M) |
| (J3) | Discrete Interface | MS3112E14-12P (M) | MS3116F14-12S (F) |
| (J4) | Output Monitor | N - Type (F) | N - Type (M) |
| (J5) | AC Line | MS3102E20-19P (M) | MS3102E20-19S (F) |
| (J6) | Redundant Interface | MS3112E16-26P (M) | MS3116F16-26S (F) |
| (J7) | Ku-Band Output | WR - 75 (G) | WR - 75(F) |

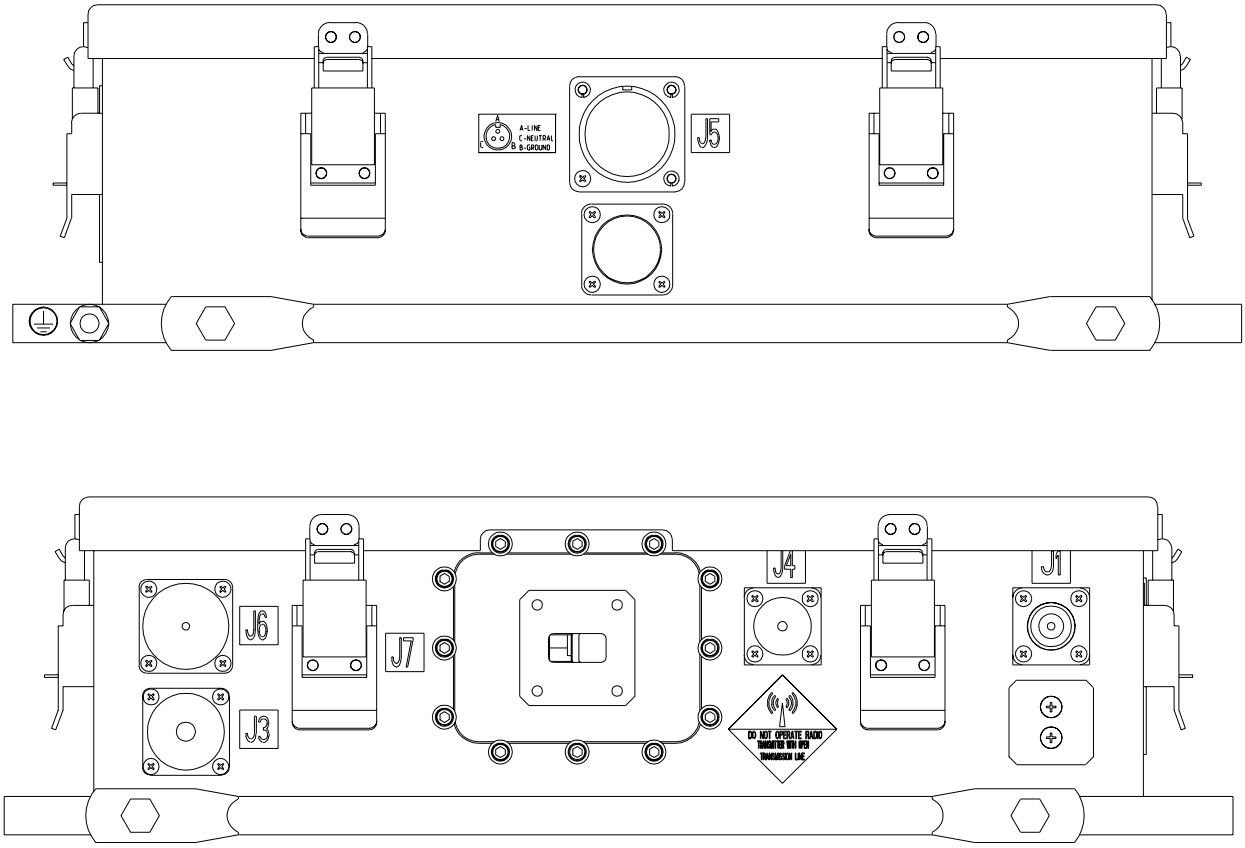


**Figure 6:** Connectors Location

# 6. PRE-POWER AND SYSTEM CHECKOUT

This Section contains instructions of how to prepare a single unit or the 1:1 redundant system for start-up with the SSPB model SSPBM-K100-BRE.

**WARNING! The information presented in this Section is addressed to the technicians who have specific training in, and knowledge of the Microwave Power Transmitters. Inappropriate use of an SSPB may cause serious injury to the operator or damage to the equipment. Do not attempt to operate an SSPB before becoming thoroughly familiar with the contents outlined in this Section.**

## 6.1 PRE-POWER PROCEDURES

Before applying prime power to the SSPB(s), verify that the following conditions are met:

1. The voltages of the station's AC prime power matches those marked on the ID label. This voltage is 220 VAC for each SSPB.
2. The prime power station is grounded properly.
3. All connections are secure and there is no evidence of pinched wires and loose hardware.
4. The main power switch on the prime power station is set to OFF.
5. For the single unit, a properly matched source connects to the RF input port and a proper load connects to the RF output port. Both ports withstanding the full CW RF power. See **TABLE 12** at page 48.
6. For the 1:1 redundant system, a properly matched source connects to the RF input port of the L-Band Splitter and the RF output port of the Waveguide Switch Assembly. Both ports withstanding the full CW RF power. See **TABLE 12** at page 48.
7. The cooling fan(s) are not obstructed.

**CAUTION!** Failure to verify these pre-power conditions may damage the SSPB(s) causing a malfunction. Operating an SSPB before verification may void the warranty.

## 6.2 OPERATIONAL SETTINGS VERIFICATION

Each SSPB arrives with all of its factory-pre-set operational values that meet the requirements of a typical installation. Before starting the SSPB(s) at the installation site, check the configurable settings and if necessary, reset to meet the customer's requirements.

# 7. OPERATION

## 7.1 INTRODUCTION

This Section describes the normal operation of the 100-Watt Ku-Band Block Up-Converter and the 1:1 redundant system. The design of this equipment allows for minimal operator intervention and maintenance. The SSPB(s) is/are completely self-controlled and can function with extreme reliability in a very harsh environment.

Each SSPB can be operated through the Discrete Interface that provides access to the unit's functions including the system monitoring of key operating parameters, remote shutdown and switching.

The Discrete Interface also provides the user with discrete fault indications, remote RF Enable capability and serial communication between the SSPB micro-controller(s) and the user's remote communication system.

The 1:1 redundant system can be upgraded easily by loading the required operating software, through the Discrete Interface port (J3) of each unit. The two SSPB are pre-loaded with the 1:1, cold standby software versions and become fully active through the Redundant Interface (J6). The operator can designate an SSPB as MUTE, effectively preventing the unit from being either on-line or on standby, thus disabling the automatic switching system.

## 7.2 SAFETY CONSIDERATIONS

The VSWR protection at the output of an SSPB is designed to protect the unit against the accidental operation with a blocked waveguide (VSWR 3:1) at the RF output. If blocked, the SSPB will generate a FAULT signal and shutdown automatically after one-second delay.

**WARNING! Prolonged operation without a load at the output may cause severe bodily harm, loss of sight, and even death. Do not operate an SSPB if the RF output connector is not connected to a load.**

Please note that an SSPB failure due to the above condition will be attributed to abuse or neglect and will not be covered by the standard warranty.

## 7.3 BASIC OPERATING PROCEDURES

Perform the following operating procedure:

1. Verify that the 'Pre-Power and System Checkout' procedure as described in **Section 6** was performed successfully.

2. Switch ON the main power source.
3. Set-up the serial communication linkage between an SSPB and the user's computer terminal. See **Sections 7.4 and 7.5**.
4. Verify that no fault or alarm messages/indications are active through the Discrete Interface.

**NOTE:** At a power failure or an accidental shutdown, an SSPB may latch into an alarm condition. The user should wait 2 minutes before restarting the system. The affected SSPB will restart in this manner, provided that a hardware shutdown is not in effect.

5. Ensure that the L-Band input signal is being applied to the SSPB(s).
6. Verify that the RF output power is set to the desired level for the SSPB(s). The SSPB gain can be adjusted by using the RS232 or RS485 software as described in **Section 7.5.1** and **7.5.2**.
7. Allow the SSPB(s) to warm up for 30 minutes, ensuring that all electrical specifications are met see **TABLE 12,** at page 48

## 7.4 USING THE SSPB SOFTWARE

### 7.4.1 HARDWARE CONSIDERATIONS

The Discrete Interface provides for the user serial communication between a personal computer or the SL-2048 modem and the micro-controller within an SSPB by using the RS232 or the RS485 protocol.

In order to use a standard IBM® compatible personal computer (running DOS 3.1 or higher) with an RS232 serial port, use the Discrete Interface cable fabricated in **Section 5.3.1**. Connect to the free end of the Discrete Interface cable, a sub-miniature D- type 25-pin or 9-pin connector with pin assignment as shown in **TABLE 6** at page 37**.** Attach the connector to the RS232 serial port of the personal computer.

In order to use the RS485 interface with a standard IBM® compatible personal computer having an RS232 serial port, it is necessary to use an RS485/RS232 adapter (provided as an option). Connect to the free end of the Discrete Interface cable a subminiature D-type 25-pin connector with a pin assignment as shown in **TABLE 7** at page 37**.** Attach the connector to the RS485/RS232 adapter**.** Connect the adapter to the personal computer.

**CAUTION!** Direct connection or direct communication with pins J, K, L and M of the Discrete Interface (J3) of an SSPB to the RS232 port of a PC may cause permanent damage to the SSPB controller.

| **TABLE 6:** SERIAL INTERFACE CONNECTION INFORMATION RS232 | | | |
|---|---|---|---|
| **Serial Interface @ (J3) Pin** | **Active condition** | **RS232 at PC Pin #** | |
| | | **DB9** | **DB25** |
| E | Serial transmit port, RS232 TX levels | 2 | 3 |
| F | Serial receive port, RS232 RX- levels | 3 | 2 |
| | Connected together | 4 & 6 | 4 & 5 |
| | Connected together | 7 & 8 | 6, 8 & 20 |
| G | System common. | 5 | 7 |

**Note:**

Cables from E and F must be a twisted pair of wires in a shielded cable and G should be connected to the shield.

| **TABLE 7:** SERIAL INTERFACE CONNECTION INFORMATION RS485 | | |
|---|---|---|
| **Serial Interface (J3) Pin #** | **Active condition** | **RS485/RS232 Adapter Pin #** |
| M | Serial transmit port, RS485 TX+ levels. | 17 |
| L | Serial transmit port, RS485 TX- levels. | 3 |
| K | Serial receive port, RS485 RX+ levels. | 14 |
| J | Serial receive port, RS485 RX- levels. | 2 |
| D | System common. | 1 |

## 7.5 SOFTWARE INSTALLATION AND SET-UP

### 7.5.1 USING THE RS232 INTERFACE

Before using the RS232 Interface, become thoroughly familiar with the items listed in **TABLE 8** and **TABLE 9** at page 39.

1. After powering up an SSPB or the 1:1 redundant system, press the 'Enter' key on the PC. The main menu similar to the one shown in **Figure 7** at page 40 will be displayed on the screen.

**NOTE:** For a single unit, the 'neighbour' portion of the main menu will not appear on the monitor screen. The micro-controller within the SSPB determines automatically whether the unit is functioning alone or in a 1:1 redundant system.

2. If necessary, to change the status for an SSPB or the 1:1 redundant system, use the commands listed in **TABLE 9** at page 39.

3. If necessary and for a 1:1 redundant system, to make the first SSPB as the 'neighbour' unit, remove the RS232 cable from the Discrete Interface port of the first unit and connect it to the Discrete Interface port of the second unit. Press the 'Enter' key to refresh the monitor screen.

**TABLE 8:** MAIN MENU ITEM DEFINITION

| Item | Description |
|---|---|
| **S/W Version** | Number of the Main Controller Board software version within the SSPB connected to the RS232 port of the computer |
| **S/N** | Serial Number of the SSPB |
| **RF Out** | Forward output power level of the applicable SSPB in dBm |
| **T1** | SSPB hottest spot temperature in degrees Celsius |
| **Refl. Power** | Reflected output power level of the applicable SSPB in dBm. |
| **Alarms Status*** | Provides three fault messages and one normal status message as follows:<br>1. Summary Alarm (excess +12 VDC current, faulty RF devices, power supply failure).<br>2. Out of Lock (no 10 MHz reference signal, RF oscillator within Up-Converter Assembly failed)<br>3. Temperature Shutdown (ambient temperature exceeds 80ºC<br>4. O.K. (SSPB is functioning properly) |
| **Status** | Indicates whether the SSPB is muted or un-muted |
| **Current** | Provides the current value of the total current consumption in amperes drawn by the +12 Volt Power supply. |
| **T2** | Temperature of the brick hot spot in degrees Celsius |
| **System Status** | Indicates whether the SSPB is functioning as a standalone unit or in a 1:1 redundant system |
| **W/G Switch** | Indicates that the SSPB connected to the computer is either placed in the on-line mode or in standby. (1:1 redundant system only) |
| **Neighbour** | All items listed below and to the right of this heading refer to the SSPB with the Discrete Interface port **not connected** to the RS232 port of the computer. (1:1 redundant system only) |

***NOTE ALARMS STATUS**

Bit 7 - Mute
Bit 6 (not used)
Bit 5 - PLL out of lock
Bit 4 - Overcurrent alarm
Bit 3 - Undercurrent alarm
Bit 2 - Summary alarm (FAULT)
Bit 1 - Temperature shutdown
Bit 0 - Temperature alarm

## Examples:

0010 0000 or 0x20 means Unit OUT OF LOCK
1000 0000 or 0x80 means Unit in MUTE state
0000 0000 or 0x00 means Unit OK

**TABLE 9:** COMPUTER TERMINAL COMMANDS FOR RS232 INTERFACE

| Key Pressed | Function |
|---|---|
| <ENTER> | Provides and refreshes the main menu display on the computer monitor screen. |
| mu | Mute function. Disables the RF devices within the SSPB with the discrete interface connected to the RS232 port of the computer. |
| un | Unmute function. Restores power to the RF devices and the RF signal output power for the SSPB connected to the RS232 port of the computer. |
| sw | Changes the switch position of the waveguide switch assembly for the SSPB connected to the RS232 computer interface port. (1:1 redundant system only) |

**TABLE 10:** RS232 INTERFACE PROTOCOL

| | |
|---|---|
| Baud rate | 19200 |
| Data Bits | 8 |
| Stop Bit | 1 |
| Parity | NONE |

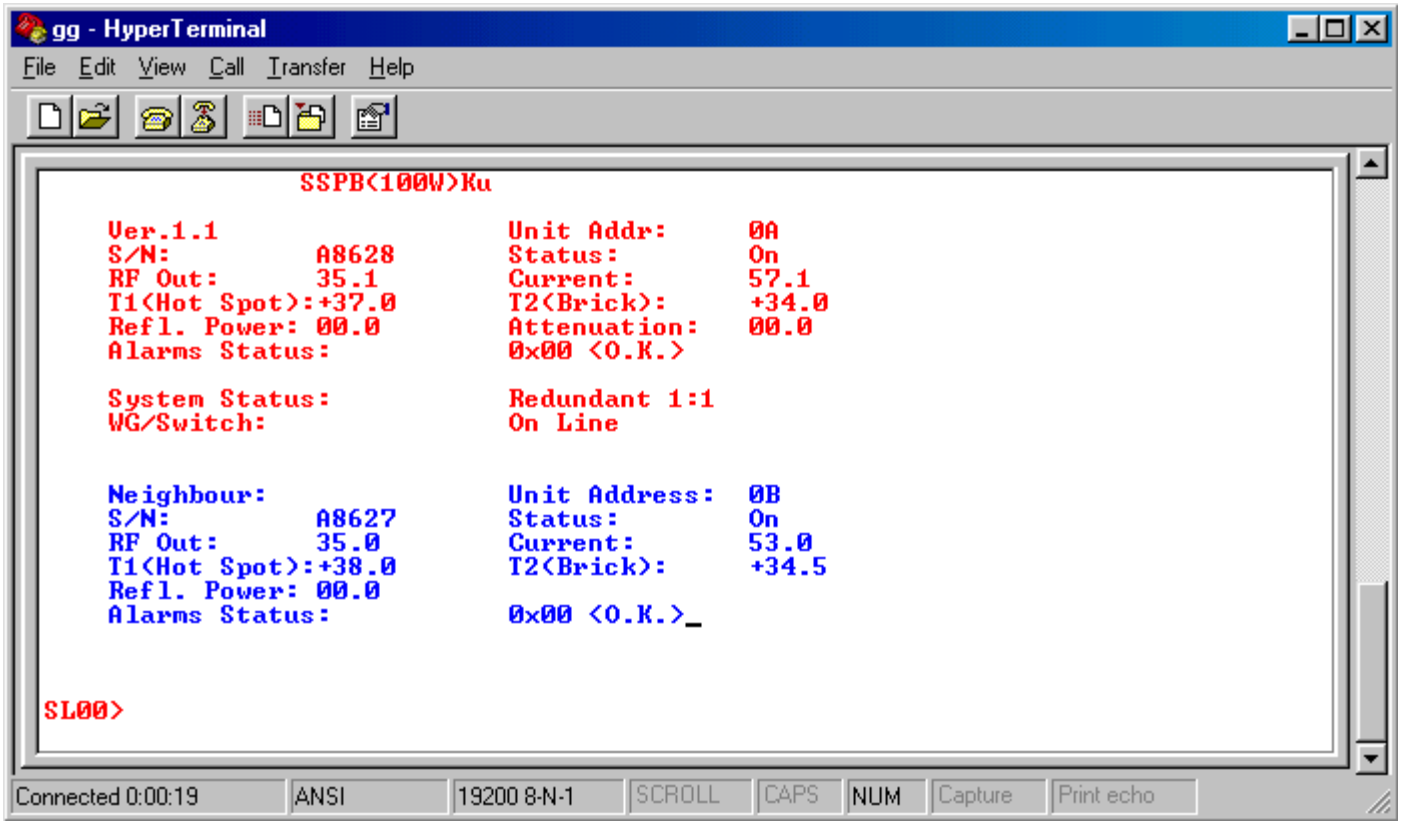


**Figure 7:** RS232 Interface Main Menu

### 7.5.2 USING THE RS-485 INTERFACE

The communication protocol for the RS485 is defined in **TABLE 11** at page 43. Before using the RS485 interface verify that the user's communication software will satisfy the criteria as specified in this Section.

#### 7.5.2.1 Packet Structure

Request packets sent from a PC must have the following items within its structure:

| | |
|---|---|
| "<" | Start of packet (0x3c) |
| NN | Address word (An ASCII number from "00" to "16" identifying the destination unit) |
| A | an ASCII character "A" |
| CC | Command byte (**Section 7.5.2.2** and **7.5.2.3**) |
| PP | Parameter bytes (**Section 7.5.2.2**) |
| . . | |
| "#" | End of packet |
| CSUM | One byte checksum |

Response packets must have all of the following items within its structure:

| | |
|---|---|
| ">" | Start of packet (0x3e) |
| NN | Address word (An ASCII number from "00" to "16" identifying the responding unit) |
| A | an ASCII character "A" |
| RR | Response bytes (**Section 7.5.2.2**) |
| . . | |
| "#" | End of packet |
| CSUM | One byte checksum |

Checksums are generated by the same formula for all packets, i.e.

(sum16(BB - 0x20) MOD 0x5f ) + 0x20 where,

| | |
|---|---|
| sum16 | is a 16-bit sum |
| BB | represents all of the bytes within the packet, including the end-of-pack byte |
| MOD | modulus operator |

#### 7.5.2.2 Query Commands

"L" Request (LEDs) digital outputs of the unit. No parameter bytes follow.
The response is an "L" followed by a string of ASCII LED's bytes ("0"-led off, "1"-led on, "2"-led flashing):

1. PA1_STAT (ALARM STATUS)
2. PA2_STAT (REDUNDANCY STATUS)

PA1_STAT

Bit 7 - Mute
Bit 6 - Overdrive
Bit 5 - PLL out of lock
Bit 4 - Over current alarm
Bit 3 - Undercurrent alarm
Bit 2 - Summary alarm
Bit 1 - Temperature shutdown
Bit 0 - Temperature alarm

PA2_STAT
Bit 7
Bit 6
Bit 5
Bit 4 - WG/S error
Bit 3 - WG/S is present
Bit 2 - Summary alarm from neighbour
Bit 1 - 0=Online, 1=StandBy
Bit 0 - 0=Standalone, 1=Redundant

Followed by,
"#" End of packet
CSUM One byte checksum

"P" request for operating parameters from the unit. No parameter bytes follow. The response is a "P" followed by a group of letter-valued strings. The values are in the (FMT1) format as described below:

The identification of parameter is followed by the numerical value.
---
"T1" temperature of the PA hotspot (degrees C)
"T2" temperature of the shroud (degrees C)
"F" forward RF power (dBm)
"R"reflected RF power (dBm)
"I (S)" summary current (A)

### 7.5.2.3 Control Commands

The byte representing the letter “X” is used as control command. The following letters represent a byte representing the mode to be controlled:

“O” represents the byte used to set the waveguide switch

“P” represents the byte used to power-up (UNMUTE) the SSPB.

“S” represents the byte used to (MUTE) the SSPB.

The above letters follow the “X” control command within the packet.

### 7.5.3 EXAMPLES OF THE COMMUNICATION PACKETS

The following sample commands address to the unit "00". The parameter bytes are arbitrary and the checksum is always shown as "c". No quotation marks (") are transmitted, they are used to delimit the packets.

Request: "<00AL#c" (Request for digital outputs.)

Response: ">00AL00FF#c"

Request: "<00AP#c" (Request for parameters.)

Response: ">00APT1+19.9T2+55.0F37.0I<4>05.50I<5>05.50I<6>000.00I<7>00.00I<S>10.00#c"

Request: "<00AXO1#c" (Set waveguide switch. No response.)
In this case, the waveguide switch will put this unit online.

Request: "<00AXP#c" (Turn on the power for the unit. No response.)

Request: "<00AXS#c" (Set unit to MUTE mode. No response.)

| **TABLE 11:** RS485 INTERFACE PROTOCOL | |
|---|---|
| Baud rate | 9600 (factory setting) |
| Data Bits | 7 |
| Stop Bit | 1 |
| Parity | EVEN |

## 7.6 1:1 REDUNDANT SYSTEM OPERATION

The 1:1 redundant system configuration contains two, high power SSPBs. For the redundancy operation, one SSPB is functioning ON-LINE where the RF output port of the unit connects to a waveguide system leading to an antenna. The RF output port of other SSPB connects to a dummy load (STANDBY status). The basic configuration and block diagram for the 1:1 redundant system is shown in **Figure 2** at page 12 and **Figure 5** at page 23.

When SSPB 'A' declares a FAULT, a signal is sent to SSPB 'B'. The standby unit responds by sending a signal to the Waveguide Switch Assembly. The signal then causes the waveguide switch to automatically transfer the RF output of SSPB 'B' from the dummy load to the waveguide system

leading to an antenna. At the same time, the RF output of SSPB 'A' is transferred to the dummy load.

SSPB 'A' must either be repaired or replaced. When reinstalled, SSPB 'B' will provide the set-up information for SSPB 'A' causing the repaired/replaced unit to become the on-line amplifier. Redundancy operation is performed automatically.

If SSPB 'B' declares a FAULT while SSPB 'A' is in FAULT or absent, no switching will occur.

Switching to the standby unit will occur by any one of the following:

- Summary Alarm signal from the working unit
- A switch command is sent through the Discrete Interface
- Waveguide Switch Assembly is switched manually (recessed control knob on switch)

When SSPB 'A' is on-line, unit B is in standby and vice versa. Both units are capable of meeting all RF performance specifications within thirty minutes after the application of prime power.

### 7.6.1 AUTOMATIC VS MANUAL OPERATION

For the normal operation of the 1:1 redundant system, automatic switching will occur to the standby unit in case of an SSPB failure. When servicing is required, temporarily disabling this feature allows the user complete control of the switching operation. Both SSPBs in the system will continue to report any alarm or fault condition while in the manual mode.

### 7.6.2 AUTOMATIC SWITCHING

Automatic switching between the two SSPBs occurs when the on-line SSPB is in a FAULT condition and the second unit is in the standby mode.

### 7.6.3 FORCED SWITCHING

By sending the correct Discrete Interface RS232/RS485 command a forced switching can take place, so as the unit which is in communication with the PC will be switched to the antenna. Note that for switching back the communication must be established for the other unit and the sw command must be issued from this unit. Forcing an SSPB on-line allows the user the option of temporarily muting the second SSPB. An SSPB in the MUTE mode is considered by the system to be unavailable as the standby unit.

| | |
|---|---|
| **CAUTION!** | The forced switching triggered by a sw command via the serial communication will set the unit presently in communication with the PC toward the antenna. In order to perform a switch back, the communication with the other unit should be previously established and the sw command should be issued from this unit. |

### 7.6.4 MANUAL SWITCHING

A recessed control knob located on the output waveguide switch is available to physically force the switch if all other measures fail. Each SSPB will detect the position of the output waveguide switch and automatically reflect the new status of each SSPB (i.e. on-line or standby).

**NOTE:** Manual switching automatically overrides and cancels any MUTE setting on either SSPB. However, if an SSPB is in a FAULT state and is manually selected to be on-line, the system will automatically switch back to the first SSPB.

The manual override switch is under a weatherproof cap located on the same side as for the circular connector. Removing the cap provides access to the switch.

# 8. MAINTENANCE

This Section describes the scheduled maintenance procedure for a standalone SSPB and the 1:1 redundant system.

**CAUTION!** Improper maintenance on an SSPB may void the warranty.

## 8.1 PREVENTIVE MAINTENANCE

This product requires minimum maintenance, which consists of visual inspection and cleaning.

**WARNING! Personnel performing maintenance on this system must have the proper training and become thoroughly familiar with the related safety requirements and issues. Read and practice the safety guidelines as described in Section 1.**

### 8.1.1 MECHANICAL PREVENTIVE MAINTENANCE

Mechanical preventive maintenance consists of verifying the condition of all mechanical parts, with the AC power switched off. Perform the following inspection:

1. With the AC power removed, check all connectors and plugs for signs of damage and for the proper seating. Replace broken connector plugs and reset any that are dislodged.
2. Inspect electrical wiring for signs of discoloured, broken or poor insulation. Repair or replace if necessary.
3. Inspect all waveguides for discoloration, cracks, loose connectors and improper sealing. Tighten or replace waveguides as required.
4. Check for other defects such as, wear, breakage, deterioration, fungus, excess moisture and mounting integrity.

### 8.1.2 COOLING FAN CHECK

Verify that the fan(s) is/are operating smoothly. Excess noise may indicate a worn fan that must be replaced. Check for debris and dust in all openings on the SSPB that may reduce the efficiency of the Cooling Subsystem.

**WARNING! Do not come in contact with any electrical assembly while power is applied.**

## 9. SAFETY AND EMC COMPLIANCE

Advantech Products are compliant with following standards:

**SAFETY:** IEC 950 (1992)
CAN/CSA-C22.2 No. 950 –92/ UL 1950

**EMC:** EN 55022: 1995 / CISPR22:1993 – Class A Conducted and Radiated Emission.
Conducted: 0.150-30 MHz,
Radiated: 30-1000 MHz.

| | |
|---|---|
| EN 50082-1: 1998 | Electrical Fast Transient Burst.<br>0.5kV Signal Lines, 1 kV Power Lines / IEC 1000-4-4 |
| EN 50082-1: 1998 | Electrostatic Discharge (contact and air discharge).<br>4kV CD, 8 kV AD / IEC 1000-4-2 |
| EN 50082-1: 1998 | Surge Immunity (AC ports).<br>1kV, 0.5 kV / IEC 1000-4-5 |
| EN 50082-1: 1998 | Power Line Quality Testing.<br>70%, 40%, 0% AC Port Dips / IEC 1000-4-11 |
| EN 61000-4-3: | Radiated Immunity.<br>80-1000 MHz @ 3 V/m 80% AM @ 1 kHz. |

**SUPPLEMENTARY INFORMATION:**

The products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and may carry the CE-marking accordingly.

## 10. APPENDIX – A: ELECTRICAL SPECIFICATIONS

Each SSPB is capable of meeting or exceeding the performance specifications listed in the following table over the frequency range, operating temperature and line voltage variation unless otherwise specified. The SSPB(s) will meet all RF performance specifications within thirty minutes after the application of prime power.

| **TABLE 12:** ELECTRICAL SPECIFICATIONS (SINGLE UNIT) | |
|---|---|
| L-Band Input Frequency | 950 - 1450 MHz |
| L-Band Input Impedance | 50 Ω |
| L-Band Input VSWR | ≤ 1.5:1 |
| Linear Gain | 70 dB ± 1 dB at central frequency and +23 °C |
| Local Oscillator Frequency | 13.050 GHz |
| Frequency Stability | Based upon internal 10 MHz reference |
| RF Output Power @ 1 dB Gain | + 49 dBm, (100 Watt in saturation) |
| Third Order Intermodulation | ≤ - 25 dBc (2 equal tones, 5 MHz apart, each at - 6 dB output back-off from 1 dB gain compression point)<br>≤ - 33 dBc (2 equal tones, 5 MHz apart, each at - 10 dB output back-off from 1 dB gain compression point) |
| RF Output Frequency Range | 14.0 – 14.5 GHz (Ku-Band) |
| Spurious | - 60 dBc, max |
| RF Output | WR-75 W/G Flange (Grooved) |
| RF Output VSWR | 1.25 : 1 |
| Amplitude Response Variation:<br>Over 500 MHz<br>Over 40 MHz | <br>4 dB, p-p, max<br>1.2 dB, p-p, max |
| Gain Variation Over Temperature | 3 dB, p-p, over the entire bandwidth |
| 10 MHz Reference Level | - 10 dBm to + 3 dBm |
| Output Phase Noise<br>Offset 100 Hz<br>1 kHz<br>10 kHz<br>≥ 100 kHz | Ku-Band Single Side Band Phase Noise<br>- 70 dBc/Hz<br>- 78 dBc/Hz<br>- 82 dBc/Hz<br>- 95 dBc/Hz |
| Operating Temperature | - 30 °C to 60 °C |
| Mechanical Package | Outdoor weatherproof enclosure |

## 11. APPENDIX – B: SSPB SHIPPING KIT P/N 195-238413-0G1

**TABLE 13:** SSPB SHIPPING KIT P/N 195-238413-0G1

| Item | Quantity | Description | Part Number |
|---|---|---|---|
| **1.** | 1 | Circular Connector , Straight Cable Plug, 3-pin for port (J5) | 631-310620-002 |
| **2.** | 1 | Circular Connector, Straight Cable Plug, 12-pin for port (J3) | 631-311612-001 |
| **3.** | 1 | Circular Connector, Straight Cable Plug, 26-pin for port (J6) | 631-311626-001 |
| **4.** | 4 | 6-32 x 1/2 inch Machine Screw | 802-632090-001 |
| **5.** | 4 | #6 Lock Washer 18-8 SS | 803-600100-001 |
| **6.** | 1 | O-ring Gasket WR75 | 820-075000-001 |
| **7.** | 1 | Ku-Band 100-Watt SSPB, model SSPBM-K100-BRE | 150-238413-2G0 |
| **8.** | 1 | Installation and Operations Manual | PM 151-238413-2G0 Rev. 5 |

## 12. APPENDIX – C: WMR-K300A REDUNDANCY KIT P/N 190-230500-0C0 (Optional, for redundant systems)

Prior to installing the 1:1 redundant system at the installation site, verify that all of the items listed in the packing list shown below are present.

**TABLE 14:** WMR-K300A REDUNDANCY KIT P/N 190-230500-0C0

| Item | Quantity | Description | Part Number |
|---|---|---|---|
| **1.** | 1 | Waveguide Switch Assembly | 240-430500-001 |
| **2.** | 2 | Safety Ground Cable | 260-100018-001 |
| **3.** | 1 | Semi-Rigid Cable Assembly | 260-130500-801 |
| **4.** | 1 | Semi-Rigid Cable Assembly | 260-130500-901 |
| **5.** | 1 | Redundant Bus Cable Assembly | 260-330500-941 |
| **6.** | 1 | L-Band Splitter | 290-300000-001 |
| **7.** | 1 | Switch Bracket | 330-152028-001 |
| **8.** | 1 | Bracket | 330-152029-002 |
| **9.** | 1 | Small Safety Ground Decal | 780-000190-001 |
| **10.** | 1 | "A" Decal | 780-000220-001 |
| **11.** | 1 | "B" Decal | 780-000230-001 |
| **12.** | 2 | 1/4-20 x 1/2 inch Hex Bolt | 800-142090-002 |
| **13.** | 4 | 1/4-20 Hex Nut 18-8 SS | 801-142010-001 |
| **14.** | 2 | 8-32 Hex Nut 18-8 SS | 801-832010-001 |
| **15.** | 2 | 6-32 x 1/2 inch Hex Machine Screw | 802-632030-009 |
| **16.** | 8 | 6-32 x 1/2 inch Machine Screw | 802-632090-001 |
| **17.** | 6 | 8-32 x 1/2 inch Machine Screw | 802-832090-001 |
| **18.** | 4 | 1/4 Lock Washer 18-8 SS | 803-140100-001 |
| **19.** | 2 | 1/4 Flat Washer Standard | 803-140200-001 |
| **20.** | 10 | #6 Lock Washer 18-8 SS | 803-600100-001 |
| **21.** | 2 | #6 Small Flat Washer 0.312 inch outer diameter | 803-600200-002 |
| **22.** | 6 | #8 Lock Washer 18-8 SS | 803-800100-001 |
| **23.** | 2 | WR 75 O-ring Gasket | 820-075000-001 |

## 13. APPENDIX – D: SSPB MOUNTING FRAME KIT P/N230-150890-101K (Optional)

**TABLE 15:** SSPB MOUNTING FRAME KIT P/N 230-150890-101K

| Item | Quantity | Description | Part Number |
|---|---|---|---|
| **1.** | 1 | Frame Assembly | 230-150890-103 |
| **2.** | 12 | 3/8-16 x 1.25 inch Hex Bolt 18-8 SS | 800-381690-002 |
| **3.** | 16 | 3/8-16 Hex Nut 18-8 SS | 801-381600-001 |
| **4.** | 16 | #3/8 Lock Washer 18-8 SS | 803-380100-001 |
| **5.** | 16 | #3/8 Flat Washer 18-8 SS | 803-380200-001 |

## 14. APPENDIX – E: "A" MOUNTING FRAME KIT P/N230-150890-401K (Optional)

**TABLE 16:** "A" MOUNTING FRAME KIT P/N 230-150890-401K

| Item | Quantity | Description | Part Number |
|---|---|---|---|
| **6.** | 1 | "A" Mounting Frame Assembly | 230-150890-402 |
| **7.** | 14 | 3/8-16 x 1.25 inch Hex Bolt 18-8 SS | 800-381690-002 |
| **8.** | 14 | 3/8-16 Hex Nut 18-8 SS | 801-381600-001 |
| **9.** | 14 | #3/8 Lock Washer 18-8 SS | 803-380100-001 |
| **10.** | 14 | #3/8 Flat Washer 18-8 SS | 803-380200-001 |

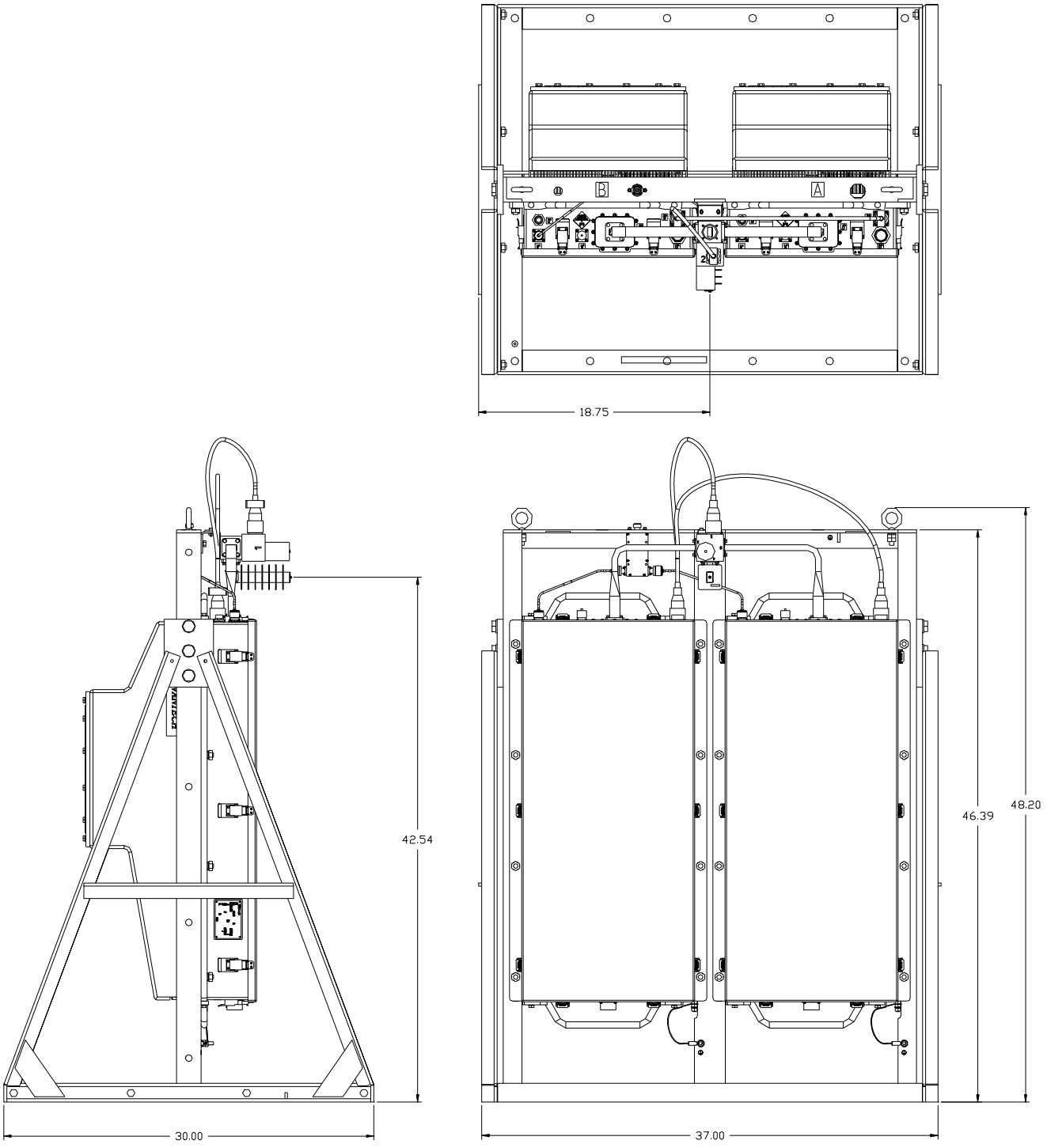


**Figure 8:** Redundant System mounted on A-frame