



**WTX-14014539/40/41-70-ES-xx**

**8 to 12 Watt, 70 dB Gain Ku-Band ODU**

**Operation and Maintenance Manual**



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# Mitec telecom inc.

Designers and manufacturers of telecom and wireless products

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Pointe-Claire, Quebec, Canada  
H9R 5Z8



**OPERATION AND MAINTENANCE MANUAL**

Preliminary

Released

## REVISION RECORD

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0		Engineering Release.	22 Jul 05	
1		Revision to add extended frequency band option	12 Sept 06	
2		Outline Drawing in Appendix A for extended band added	01 Nov 06	

**CM Approval**

**TITLE:**

**WTX-14014539\_40\_41-70-ES-xx  
High Power Transmitter Module**

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**REV 2**

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**PAGE 1 OF 36**

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# Preface

## Scope

This document covers the installation, operation, and maintenance of the WTX-14014539\_40\_41-70-ES-xx High Power Transmitter Modules. It contains information intended for engineers, technicians and operators working with the transmitter module.

To make inquiries, or to report errors of fact or omission in this document, please contact **Mitec telecom inc.** at (514) 694-9000.

## ***IMPORTANT***

Important information concerning the operation and care of this product, as well as safety of authorized operators is highlighted throughout this document by one of the following labels:

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### **NOTE**

*Indicates a reminder, a special consideration, or additional information that is important to know.*

---

### **CAUTION!**

*Identifies situations that have the potential to cause equipment damage.*

---

### **WARNING!!**

*Identifies hazardous situations that have the potential to cause equipment damage as well as serious personal injury.*

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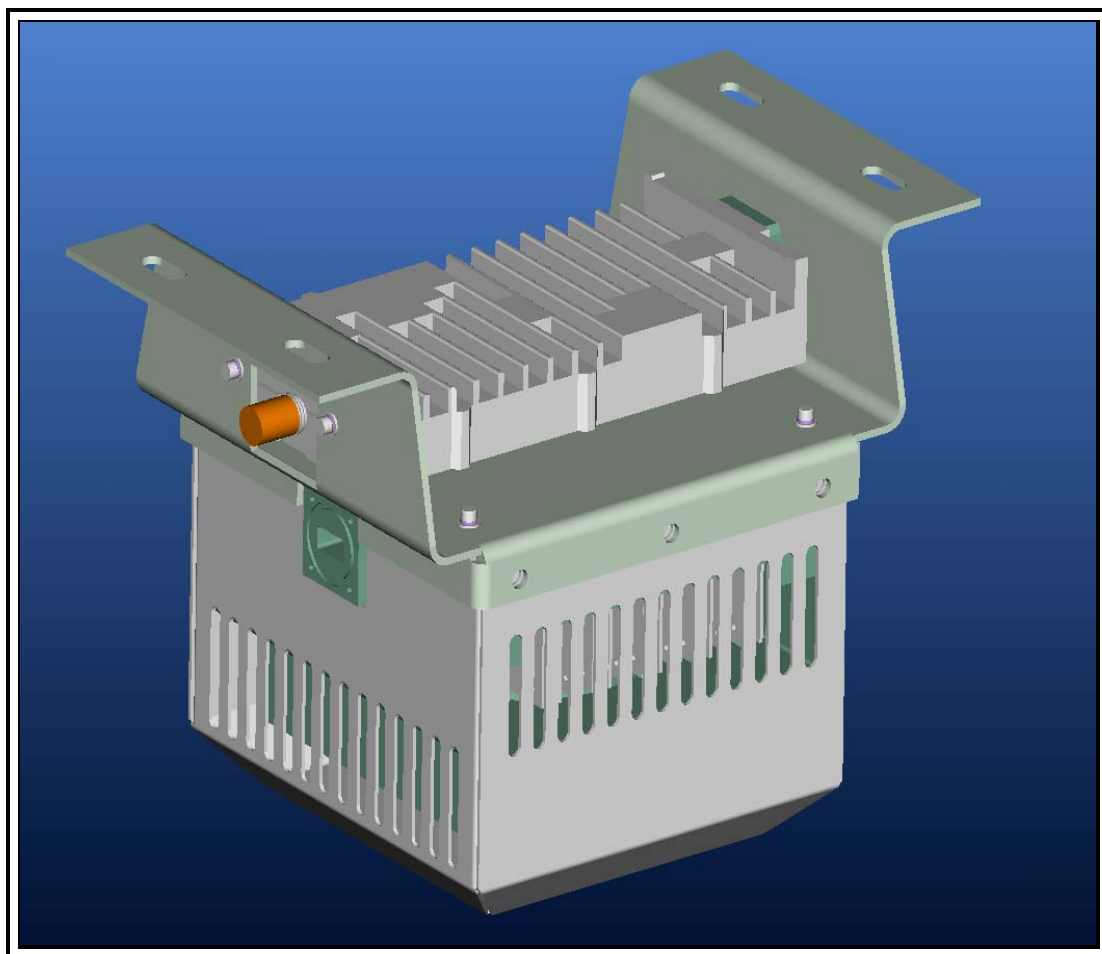
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# 1 Introduction

The WTX-14014539\_40\_41-70-ES-xx High Power Transmitter Modules are highly reliable, high quality, cost efficient stand-alone transmitter systems. The application for these modules is Ku-Band VSAT communication in an outdoor environment. This line of superior products, engineered using state of the art technology, is characterized by unparalleled durability and dependability.



## 1.1 Receiving and Inspection

The transmitter module is designed to function outdoors and will arrive in a standard shipping container. Immediately upon receipt of the transmitter module, check the Bill of Lading against the actual equipment you have received. Inspect the shipping containers exteriors for visible damage incurred during shipping.

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### CAUTION!

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*Handle the transmitter module with extreme care. Excessive shock may damage transmitter module's delicate internal components.*

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### NOTE

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*Before unpacking the shipping containers, move them near to the site where the system will be mounted. Ensure that the containers are oriented correctly in accordance with the "This Side UP" labels. Carefully remove the transmitter module and packing material from the shipping containers.*

Using the supplied packing list, verify that all items have been received and undamaged during shipment. Verify that all items are complete. If there are any omissions or evidence of improper packaging, please notify **Mitec telecom inc.** immediately.

### 1.1.1 Equipment Damage or Loss

**Mitec Telecom Inc.** is not responsible for damage or loss of equipment during transit. For further information, contact the responsible transport carrier.

When declaring equipment as damaged during transit, preserve the original shipping cartons to facilitate inspection reporting.

### 1.1.2 Return of Equipment

When returning equipment to **Mitec** for repair or replacement:

1. Identify, in writing, the condition of the equipment,
2. Refer to the sales order, Purchase Order and the date the equipment was received.

Notify **Mitec Sales Administration Department** of the equipment condition and obtain a Return Material Authorization (RMA) number and shipping instructions. **Mitec** will pay for the cost of shipping the product to the customer after the repairs are completed.

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## NOTE

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*Do not return any equipment without an RMA number. This is important for prompt, efficient handling of the returned equipment and of the associated complaint.*

## 1.2 Preparing for Installation

Before attempting to install or use the transmitter module, we recommend that you first familiarize yourself with the product by reading through this manual. Understanding the operation of the system will reduce the possibility of incorrect installation, thereby causing damage or injury to yourself or others.

*The transmitter module **must** be installed in accordance with the conditions and recommendations contained in the following sections.*

When you are ready to begin your installation, use the information in Chapter 2 (Installation) as a guide for making all the required electrical connections.

### 1.2.1 Safety Precautions

Carelessness or mishandling of the transmitter module may damage the unit causing serious injury to yourself or others. Please adhere to the following:

---

## WARNING!!

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*This unit is equipped with an AC power cord and plug. Do not tamper with, or attempt to reconfigure, the cord or plug supplied with the unit, as this can:*

- ◆ *result in personal injury*
- ◆ *void the warranty*
- ◆ *cause damage to the units or related equipment.*

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# 2 Installation & Overview

## 2.1 General Description

This section describes the installation and theory of operation of the transmitter module.

The modules are stand-alone Transmitter Systems powered from 24 VDC and 110/220 VAC power sources. They will amplify an input signal from an L-Band RF source up to power levels of 8, 10, or 12 Watts CW in Ku-Band as shown below.

Model	Power Level
WTX-14014539-70-ES-xx	8 Watts
WTX-14014540-70-ES-xx	10 Watts
WTX-14014541-70-ES-xx	12 Watts

The Transmitter consists of a low power block up-converter (BUC) and a high power amplifier (Booster.)

The Booster has control and protection functions and consists of these major sub-systems: the RF Amplifier, and power supply and a cooling system. The amplifier section contains all the necessary DC power conditioning circuitry for bias and sequencing of the RF amplifier devices as well as a RS-485 monitor and control interface, depending on the model option.

The module can be used as a stand-alone unit or in a redundant configuration.

## 2.2 Specifications

Table 1 summarizes the specifications of the WTX-14014539\_40\_41-70-ES-xx High Power Transmitter Modules, where XX represents the output power, and YY represents the configuration and ZZZ represents the frequency band. For mechanical specifications, refer to the outline drawing, Figure 4 in Appendix A.

**Table 1 –Specifications**

RF Performance	
Output Frequency	
WTX-140145XX-70-ES-YY	14.0 to 14.5 GHz
WTX-137145XX-70-ES-YY	13.75 to 14.5 GHz
IF Frequency	
WTX-140145XX-70-ES-YY	950 to 1450 MHz
WTX-137145XX-70-ES-YY	950 to 1700 MHz
Reference Frequency	10 MHz External Reference; (0 ± 5) dBm Input Power Level
Small Signal Gain	69 dB, min over temperature

<b>RF Performance</b>	
Gain Flatness (small signal) at 10 dB back-off	$\pm 2.5$ dB, typ. ( $\pm 3.5$ dB max) over full band $\pm 0.3$ dB, p-p, max. over any 40 MHz
Gain Stability with power (expansion)	0.5 dB, max.
Output Power WTX-ZZZ14539-70-ES-YY WTX-ZZZ14540-70-ES-YY WTX-ZZZ14541-70-ES-YY	39.0 dBm (8 W), min at P1dB 40.0 dBm (10 W), min at P1dB 41.0 dBm (12 W), min at P1dB
Saturated Output Power WTX-ZZZ14539-70-ES-YY WTX-ZZZ14540-70-ES-YY WTX-ZZZ14541-70-ES-YY	40.0 dBm (10 W), typ. at PSAT 41.0 dBm (12 W), typ. at PSAT 42.0 dBm (16 W), typ. at PSAT
3 <sup>rd</sup> Order Intermodulation (IMD-3)	-26 dBc typ., two equal signals at 6 dB back off from P1dB rated total; 5 MHz separation
Phase Noise	-60 dBc/Hz, max. @300 Hz offset of the carrier -70 dBc/Hz, max. @ 1 kHz offset of the carrier -80 dBc/Hz, max. @ 10 kHz offset of the carrier -90 dBc/Hz, max. @ 100 kHz offset of the carrier -100 dBc/Hz, max. @ 1 MHz offset of the carrier
Integrated Phase Noise Error	2.2 degrees, max. from 300 Hz to 1 MHz SSB
Phase Perturbation	4 degrees, max for full (5ms) pulse: 3 degrees p-p max. from the starting 30 usec
Source & Load VSWR	1.5:1 max (operational), infinite at any angle without damage, unconditionally stable
Input Return Loss (cold)	-14 dB typ.
Output Return Loss	-17 dB max.
Spurious In-band	-50 dBc, max @ P1dB
Spurious Out of Band	-60 dBc, max @ P1dB
Harmonics	-55 dBc, typ. @ P1dB
RF Monitor Port (optional)	N/A
Power Consumption	120 - 150 W typical
<b>Power Supply</b>	
Input	110/220 VAC, 300W min. typical 48VDC optional
Output	N/A
Cooling	Forced Air
Efficiency	85% nominal
Design Technology	High frequency switching modules
<b>Mechanical Specifications</b>	
Package	Outdoor, weather resistant
Size (overall dimensions)	13.5"x8.25"x10"
Weight	6 Kg (13.2 lb) typical
Cooling	Forced Air
Exterior Surface Finish	Painted off-white
Hardware	Stainless Steel

<b>RF Performance</b>		
O-ring	Silicone	
<b>Markings</b>	<b>Labels permanent and legible</b>	
1	Mitec Part No & Revision Level	
2	Serial No.	
3	IF Input	
4	RF Output	
5	M&C, if applicable	
6	AC Input	
<b>Environmental</b>	<b>Operational</b>	<b>Storage</b>
Temperature	-40 <sup>0</sup> to 55 <sup>0</sup> C	-50 <sup>0</sup> C to 85 <sup>0</sup> C
Humidity	5% to 95% at -40 <sup>0</sup> C	5% to 95% at 65 <sup>0</sup> C
Altitude	10,000 ft AMSL	40,000 ft AMSL
Shock and Vibration	Normal transport and handling	
Drop	N/A	1m in shipping container
<b>Reliability</b>		
MTBF (mean time between failures)	118,000 hours (fan reliability data is not included. Fan must be replaced once every 2 years minimum.	

**2.2.1 Controls, Indicators and Connectors**

The controls and indicators pertaining to this specific model, as well as a table listing the connector pin-outs, are described in the bench test record (BTR), found in Appendix B.

**2.2.2 General Considerations**

The module shall meet all specifications over full bandwidth and under all environmental conditions when terminated with a load of VSWR at 1.5:1 unless otherwise specified. All RF specifications shall be met within five minutes after applying DC power, except gain flatness, which shall be met after a warm-up period of ten minutes. During the warm-up period, the module shall not exhibit any alarm or require an RF mute input signal to reset any alarm/fault latches.

**2.3 Basic Mechanical Characteristics**

**2.3.1 External View of the Transmitter Module**

The physical external dimensions of the transmitter module are shown in Figure 4 and Table 1. All inputs and outputs are shown in Figure 4.

### 2.3.2 Connections and Mounting Hardware

The IF input connection requires a coaxial cable with an N-type male connector for the IF Input. The RF output requires a waveguide with a WR75 flat flange. An O-ring shall be used to seal the waveguide connection. There is also a cylindrical connector on the RF Input side of the RF amplifier for AC power. The pin assignments for the connectors are shown in section 3.

Four brackets each with #1/4 hardware fasten the SSPA and the BUC onto the mounting frame for adequate support. Fasten the frame with the BUC and SSPA on it to the beam using two U bolts and corresponding hardware, using the adjustable nuts to adjust the level.

See Figure 4 in Appendix A. Four cap screws (#6-32) and their respective lock washers fasten the antenna waveguide feeder on to the transmitter waveguide output flange. The mating connectors, hardware and O-ring are in the shipping container with the transmitter.

## 2.4 Assembly and Installation

Use the information in this section as a guide to assemble and install the transmitter module. The specified humidity is up to 100% during operation. However, installation should be carried out in dry conditions, free of salt spray or excessive humidity. This will eliminate the possibility of moisture and other foreign substances from entering the output waveguide flange.

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### CAUTION!

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*Only authorized technical personnel should perform the installation and proper electrical hookups of the transmitter module.*

### 2.4.1 Lifting the Transmitter Module into Position and Temporary Attachment

The transmitter module weighs approximately 6 kg (13.2 lb), which may be handled by one person. Remove all plastic caps from the connectors and output waveguide flange. Lift the transmitter module. The transmitter module is now ready for permanent attachment.

The transmitter is designed to operate in an outdoor environment and is waterproof when mounted in the correct orientation as per Figure 1 and the orientation labels placed on the RF amplifier shroud.

The transmitter contains high flow-rate fans (300 CFM) for cooling the RF amplifier module. These fans function continuously during the transmitter operation. To provide a sufficient airflow, the transmitter should be mounted with a minimum clearance of 3 inches on all four sides and the bottom. Refer to Figure 1. Adequate cooling for the transmitter will provide years of top performance.



### 2.4.2 Securing the Transmitter Module

Secure the transmitter module on to the mounting frame using the hardware described in section 2.3.2. Align the transmitter output waveguide flange with the mating flange of the antenna feeder waveguide. Using the O-ring and hardware provided, connect the antenna feeder waveguide. Torque the flange screws to 16 inch-pounds (1.8 N-m). Attach the proper cables for waveguide for IF input, AC power and M&C to the corresponding connectors of the transmitter module. Refer to Figure 4 in Appendix A.

#### NOTE

*The cylindrical connectors are labeled clearly and have different pin layouts. Refer to Figure 4. It is impossible to incorrectly install the mating connectors.*

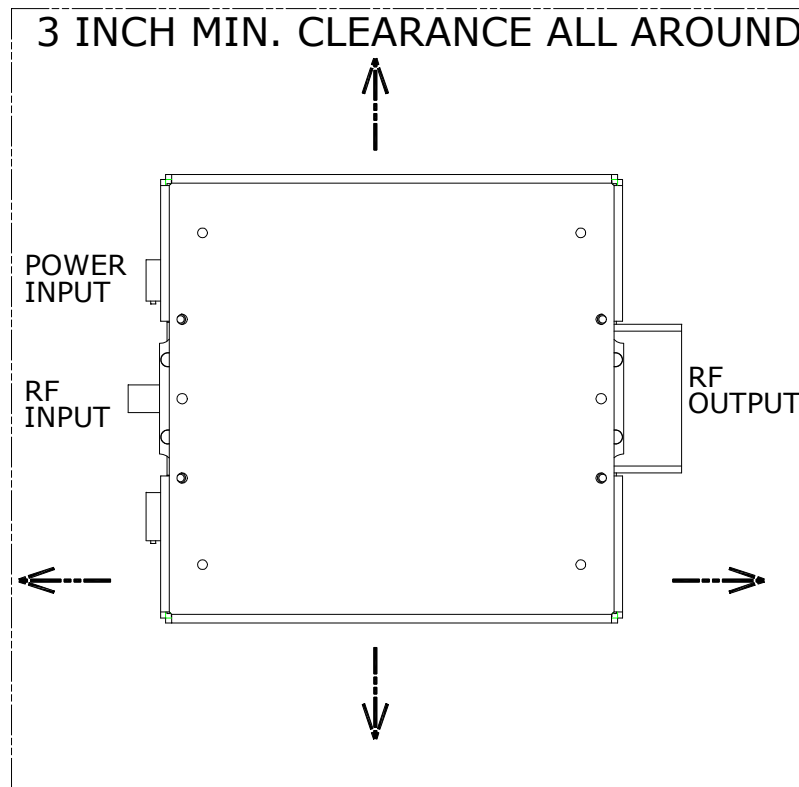


Figure 1 – Recommended Distance for Mounting on the Hub

## 2.5 Functional Overview

### 2.5.1 General

This section describes the transmitter module functions in detail. The functional overview explains the RF amplification, monitor & control and power distribution.

Figure 2 block diagram illustrates the transmitter module.

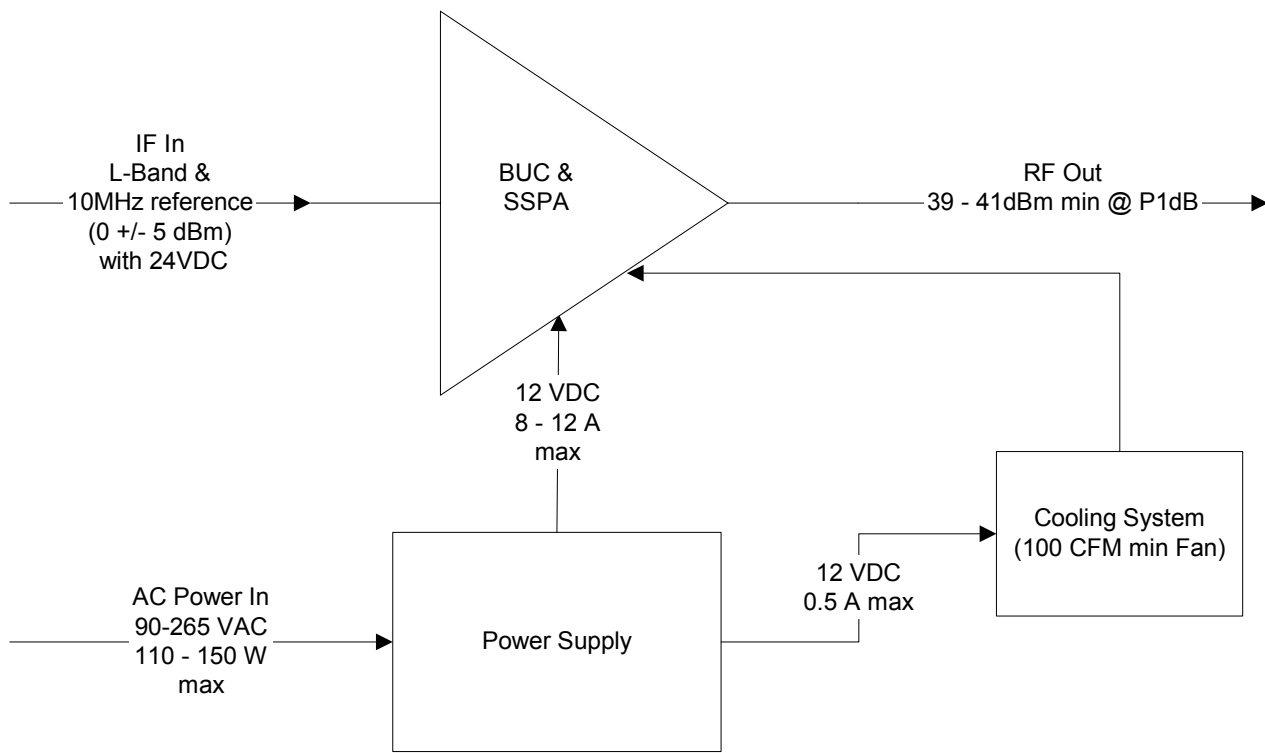


Figure 2 - System Block Diagram

### 2.5.2 IF/RF Conversion and Amplification

The IF Input signal with a 10MHz reference, 0-/+5dBm and 24VDC, 1.5A nominal enters the BUC by a coaxial cable, converted to Ku-Band by the BUC and goes through an isolator, which provides a good VSWR at the input. Under normal operation, the RF amplifier will amplify the RF Input signal level up to a power level of 39 to 41 dBm (8 to 12 Watts CW) P1dB minimum. For small signal gain, the transmitter module is capable of providing a gain of approximately 70 dB.

To achieve the rated output power, GaAs transistors, as well as other microwave components within the RF Amplifier, provide the necessary gain and low insertion loss. The amplified signal is transmitted through the output waveguide section to a satellite up-link system.

### 2.5.3 Protection and Control

The protection and control circuitry are contained within the RF Amplifier

A control section contains all of the necessary DC power conditioning circuitry for providing the proper bias and sequencing of the RF amplifier devices. The protection function within the control section includes over temperature shut down.

The SSPA has a temperature sensor on the hot spot of the unit. If the temperature of the SSPA hot spot exceeds 85<sup>0</sup> C., the RF amplifier module will shut down until the condition is corrected.

#### **2.5.4 Internal Power Distribution Reference**

The transmitter module operates from power source of 24 VAC for the BUC and 90 VAC to 265 VAC, 47 to 63 Hz for the SSPA. It will consume approximately 120 to 150 watts.

The power supply converts the incoming AC voltage into two separate DC voltages. The DC voltages are regulated to ensure isolation and stability. The module provides:

- 12 VDC, 8 to 12A maximum to the RF amplifier circuits
- 12 VDC, 0.5A maximum to the cooling system fan. Refer to Figure 2

The power supply is capable of 85% efficiency.

If the voltage exceeds its maximum value, the power conditioner board will shut down the SSPA until the over voltage condition is corrected. Inrush current will not trip this protection circuit.

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# 3 Operation

This chapter describes the verification of the operation and control of the transmitter module. It shall be performed by authorized personnel prior to maintenance and/or repair.

## 3.1 Procedure

Verify that the installation procedure described in Chapter 2 was completed. A complete physical check of the customer's system is suggested.

---

### WARNING!

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*The output power available at the output waveguide flange is extremely hazardous. Under **no circumstances** should be transmitter be operated without the waveguide feed or a high power load attached. Do not operate this equipment in the presence of flammable gases or fumes. Failure to observe this precaution will result in personal injury. Safe and careful installation of this transmitter will eliminate the possibility of accidents and provide years of top performance.*

Verify the antenna feed waveguide connection is properly done before the transmitter is energized.

---

### NOTE

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*The transmitter module can withstand any source or load VSWR. However, the transmitter module will meet all specification requirements only if the source/load VSWR is sufficient. Refer to Section 2.2*

*Normal operation is not possible if the antenna feeder VSWR is greater than 1.5:1.*

Turn ON the power and allow a warm up period of twenty minutes before operating the transmitter module. This will assure stable gain and power. The transmitter module can function with a coupler when a direct measurement of the output power is made.

---

**CAUTION!**

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*It is strongly recommended not to exceed -20 dBm maximum RF Input level. The RF amplifier will be in deep saturation if overdriven. RF performance will degrade significantly, and proper operation is not possible. This operational condition is the survival mode for the transmitter module. Never exceed the maximum safe IF Input level of -20dBm (0.01W) or permanent damage to the transmitter module may result.*

**3.1.1.1 Interface**

The connector interface is described in the Bench Test Record, in Appendix B.

# 4 Maintenance

This chapter contains information on how to maintain, troubleshoot and repair the transmitter module. The transmitter module is extremely reliable, requiring very little preventive maintenance, or repair. Should there be a malfunction, this chapter also contains technical information to help diagnose basic failures.

## 4.1 Preventive Maintenance

### 4.1.1 Procedure

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#### WARNING!

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*Shut down the transmitter module before disassembly and remove all cables and connectors. Failure to observe this precaution may result in personal injury or death. This includes the removal of any RF power originating from other system components.*

When the transmitter module is in the hot stand-by mode in a redundant system, switch it to the operation mode at least once every three months. Make sure the fan is running while in operation mode.

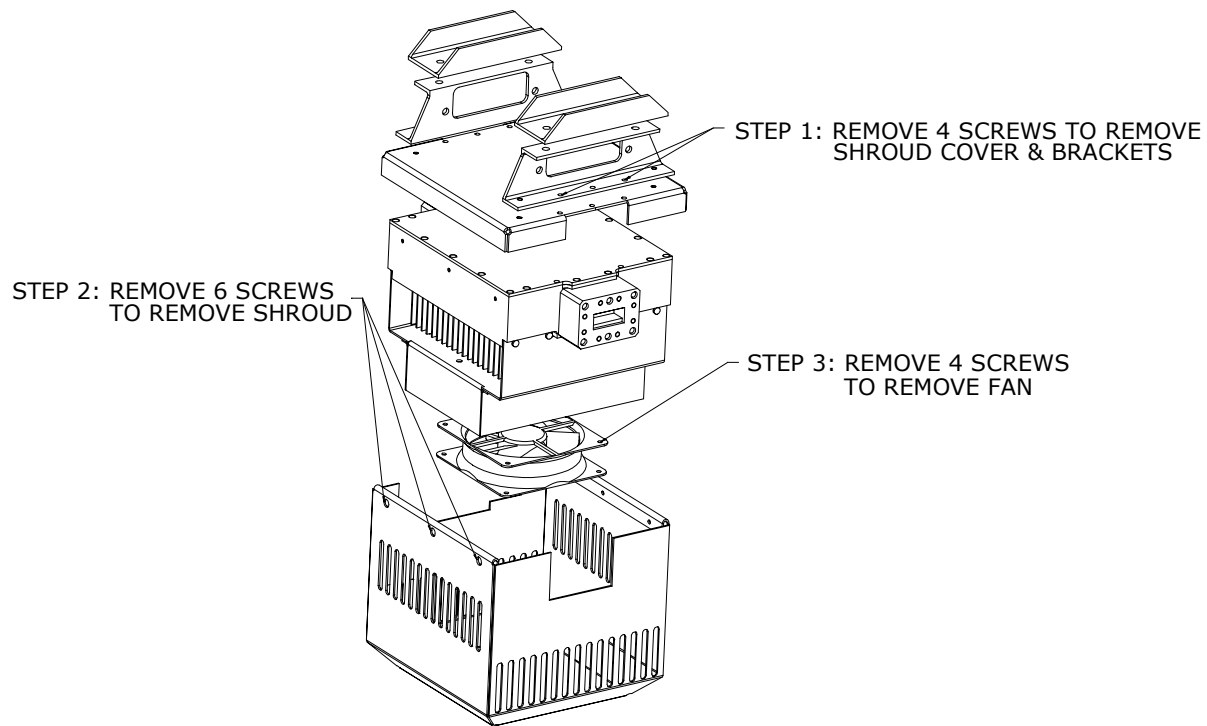
When the transmitter module is in the cold stand-by mode in a redundant system, switch it to the operation mode at least once every three months. Make sure the fan is running while in operation mode.

### 4.1.2 Transmitter Module Cooling System Preventive Maintenance

Preventive maintenance is limited to checking the performance of the transmitter module cooling system. No electrical or mechanical adjustments are required for normal operation.

The fan is the least reliable item in the transmitter module. Wearing of the fan bearings will cause the RPM to drop and will create a higher than average heat-sink temperature. It is recommended to replace the fan after 2 years of operation.

The Cooling system was designed so that the fan can be replaced easily in the field. Refer to Figure 3 below.



**Figure 3 – Cooling Fan Replacement**

To replace the fan, perform the following:

1. Remove four screws from top shroud cover and brackets (step 1);
2. Remove six screws and then slide down bottom shroud cover (step 2);
3. Disconnect fan and then remove four screws holding fan onto bracket (step 3);
4. Replace fan;
5. Connect fan;
6. Install bottom shroud cover with six screws.
7. Install top shroud cover and brackets with four screws.

The transmitter module is now ready for operation and no other periodic maintenance is required.

#### **4.1.3 Performance Check**

Verify the system is properly set up as per Chapters 2 and 3. The power output at 1 dB compression shall be measured for evaluating the performance of the transmitter module.



It is recommended to measure the following parameters for ensuring that the transmitter module is in good working condition:

- Gain and Gain flatness
- RF load VSWR and RF source VSWR
- Two-Tone Intermodulation Distortion
- Return Loss at connectors J1 and J2 of the TRANSMITTER MODULE

Using a Source and an IF input signal level within the small signal region of the transmitter module, measure the power level at connectors J1 and J2. See Figure 4. Plot the swept response on a test data sheet. From the plot, determine gain and gain flatness.

With an IF Input signal level within the small signal region of the transmitter module, measure the VSWR (Return Loss) at connectors J1 and J2. See Figure 4. Plot the swept return loss for both the IF Input and RF Output signals on a test data sheet. From the plot determine the return loss.

From the output power measurements determine P1dB. Record value on a test data sheet.

Measure the Two-tone Intermodulation Suppression using two equal signals separated by 5 MHz. Record value on test data sheet.

#### 4.1.4 Troubleshooting

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### WARNING!!

---

*Cable connection and disconnection shall be done carefully to avoid physical damage to the cables and connectors, which may cause intermittent problems in the future.*

Use Table 1 to quickly isolate a fault within the transmitter module. If the transmitter module is defective, notify Mitec and follow the process detailed in section 1.1.2.

Symptom	Action
Fails performance test	Check power source, RF source, cabling and connectors. Check for clogged fan and debris in heat-sink fins. Clean thoroughly. If fan is worn, replace fan. If correct, transmitter module is defective. Return transmitter module to Mitec.

**Table 2 - Recommended Corrective Actions**

#### 4.1.5 Out-of Warranty Repair

A non-warranty and out-of-warranty repair service is available from **Mitec** for a nominal charge. The customer is responsible for paying the cost of shipping the SSPA both to and from **Mitec** for these repairs.

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# *Appendix A*

## *Drawings & Schematic Diagrams*

WTX-14014539\_40\_41-70-ES-xx High Power Transmitter Module - Outline Drawing

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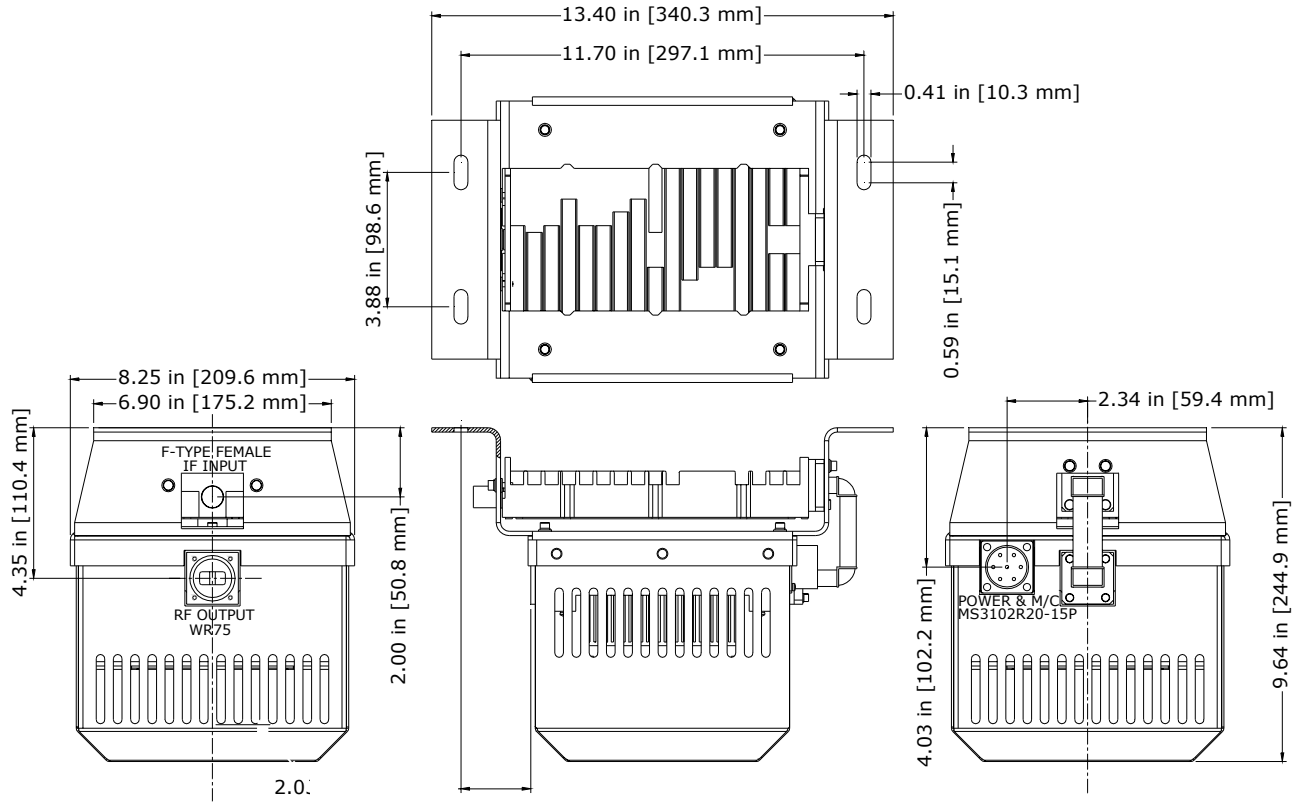
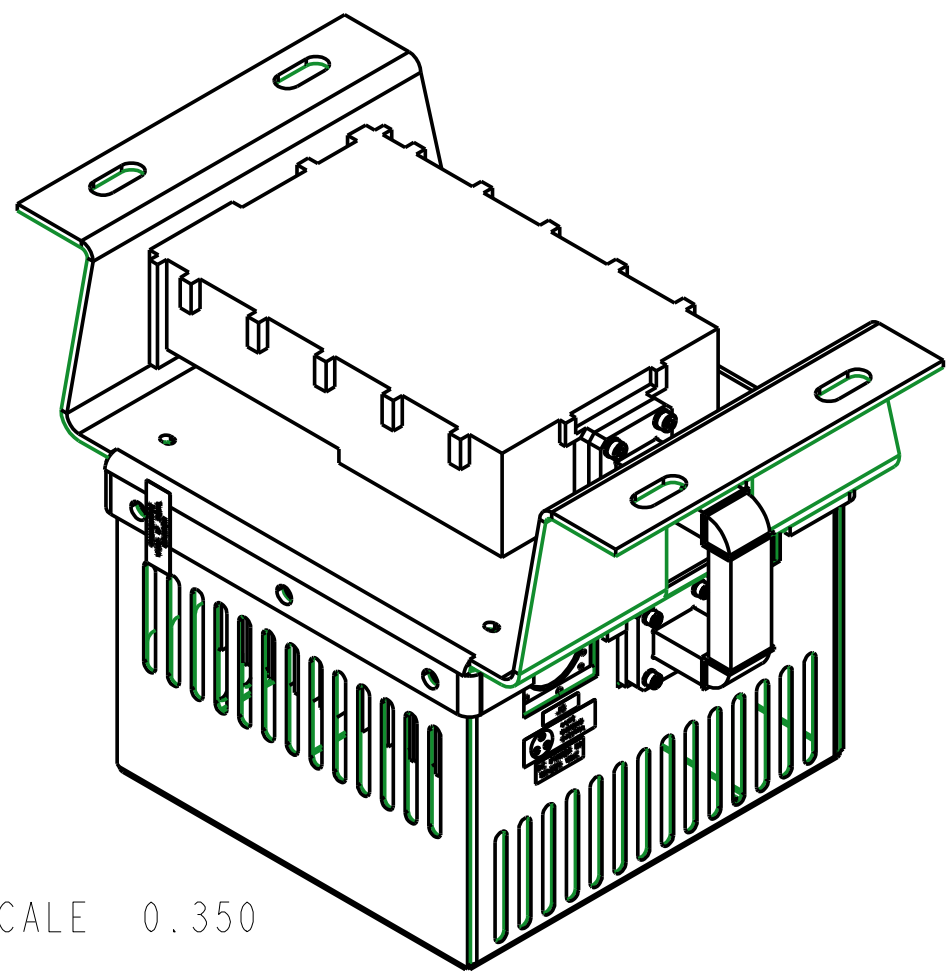


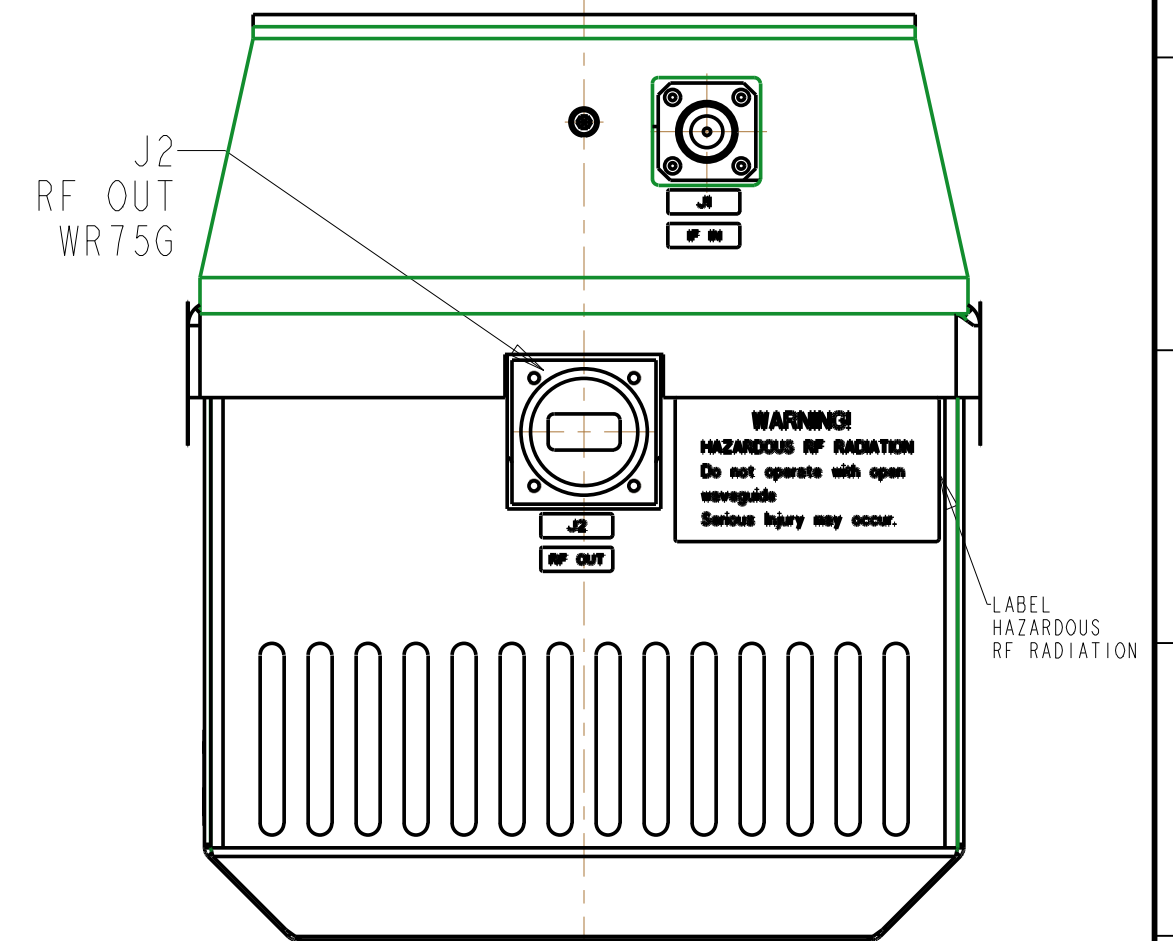
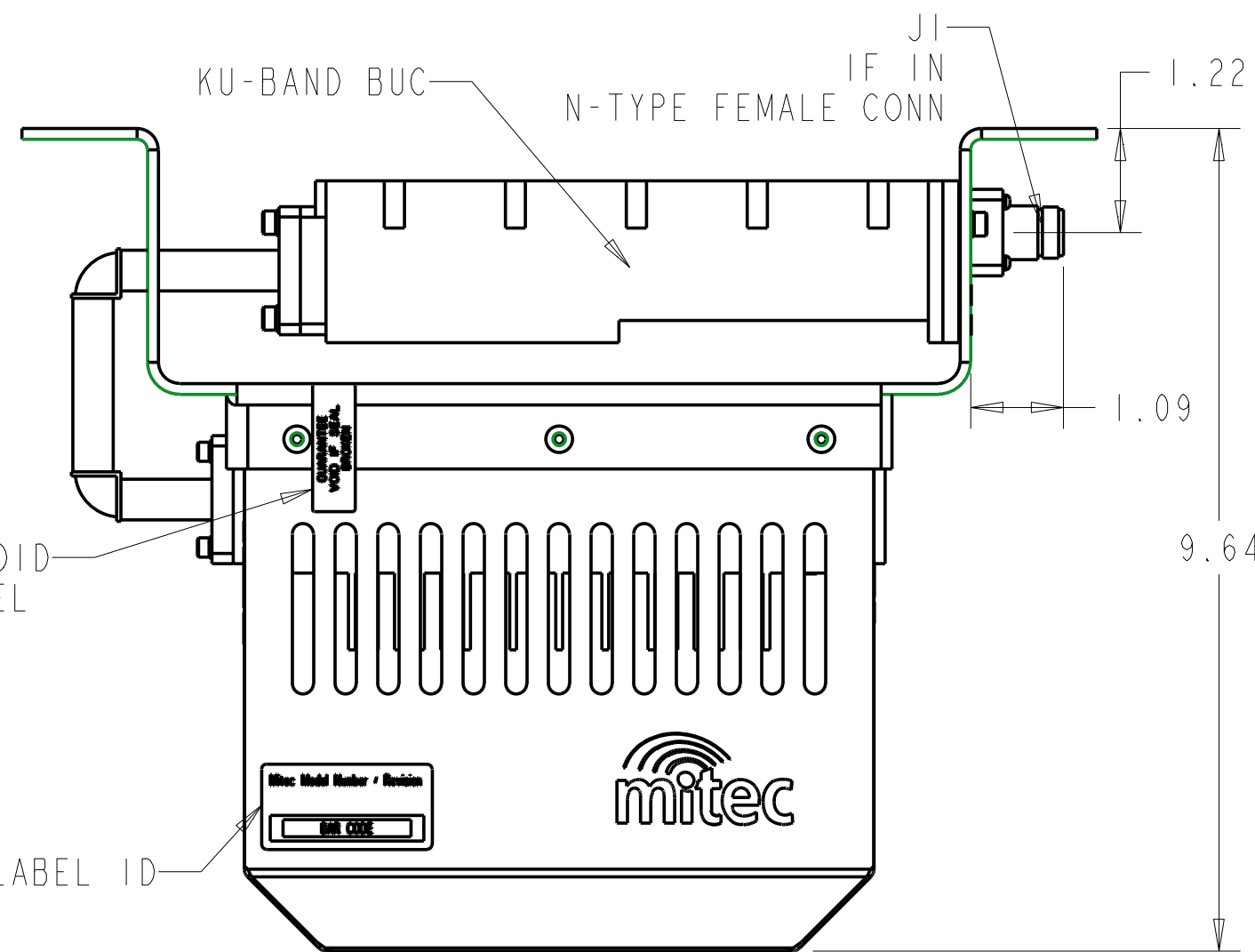
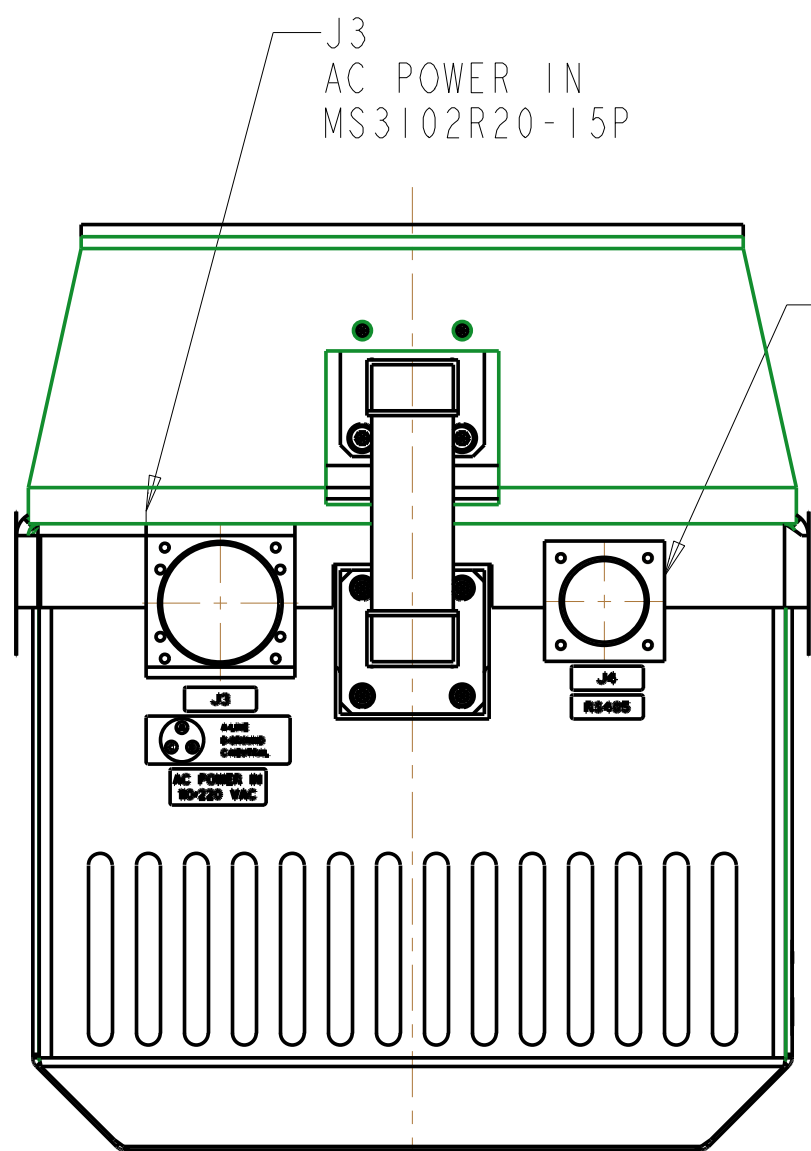
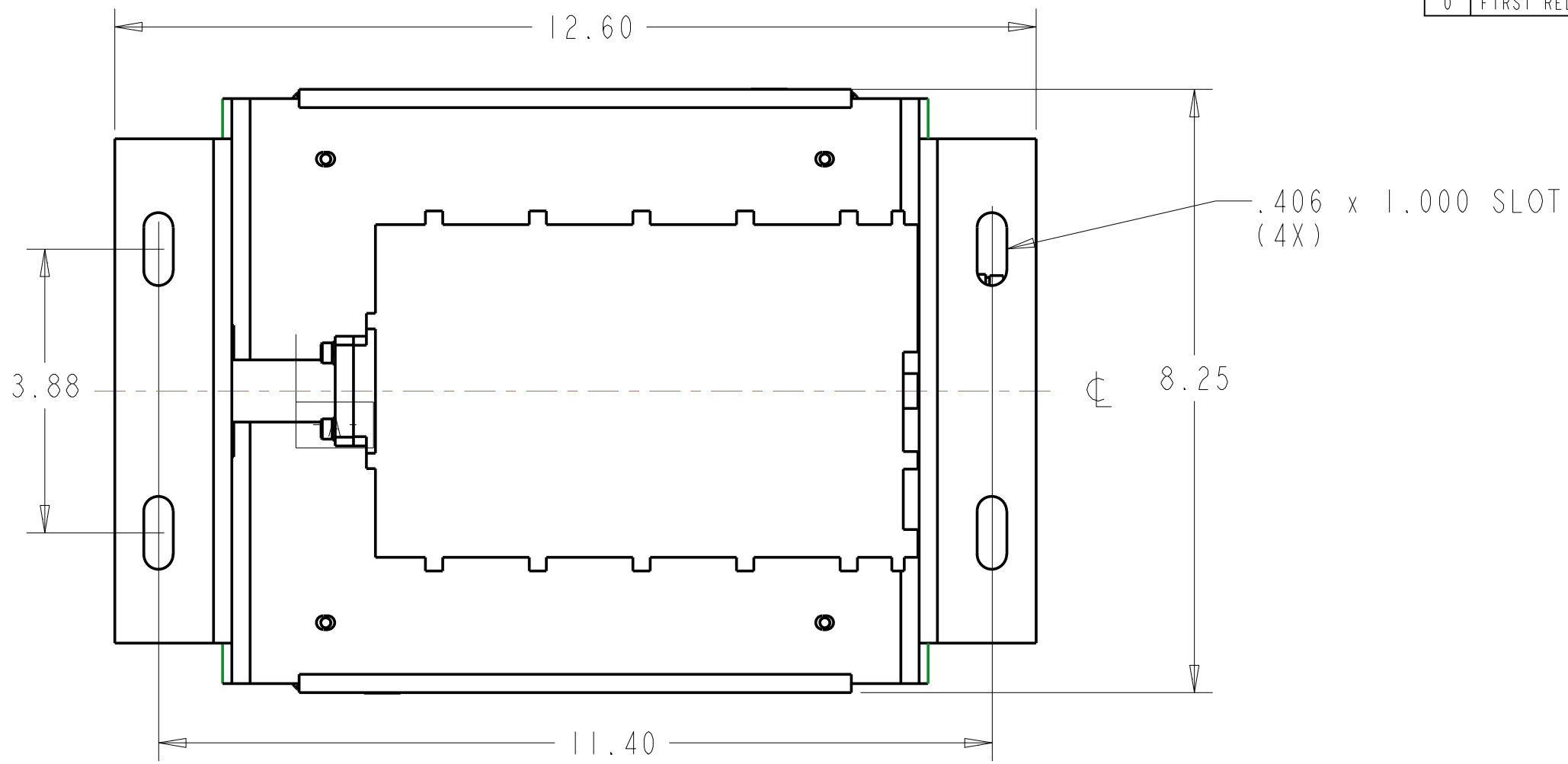
Figure 4 – Outline Drawing

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REVISION			
REV	DESCRIPTION	DATE	APP
0	FIRST RELEASE	Sep 20, 06	SH



SCALE 0.350



DRAWING		PART		UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES			TITLE: 8W EXT KU BAND BOOSTER WITH BUC		
NO.	WTX-13714539-70-ES-35MD	WTX-13714539-70-ES-35		BASIC DIMENSIONS	2 DEC.	3 DEC.	MATERIAL:		
REV	0	0		UP TO 6.00	± .02	± .005	FINISH:		
STATE	RELEASED	RELEASED		ABOVE 6.00 TO 24.00	± .03	± .010	This drawing is private and confidential and is supplied on the express condition that it is not to be used for any other purpose or copied or reproduced in any form or communicated to any other person without the written consent of: MITEC TELECOM INC.		
ORIGINATOR	SOUMITRA HALDAR	DATE:	Sep 20, 06	ABOVE 24.00	± .06	± .015			
DESIGNER	M. LISSIANSKAIA	DATE:	Sep 20, 06	ANGULAR DIMENSIONS	± 1/2 deg.				
				FRACTIONAL DIMENSIONS	± 1/64				
				SURFACE FINISH	✓		PROJECT NO: / JOB NO:		
				DO NOT SCALE DRAWING				NEXT ASSEMBLY:	
								CAGE IDENT. NO:	38494
								SIZE:	C
								DRAWING NO:	WTX-13714539-70-ES-35MD
								SCALE:	0.500
								SHEET:	1 of 1



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# *Appendix B*

## ***Bench Test Record***

Appendix B contains the bench test record for the product version described herein.



# *Appendix C*

## ***Serial Protocol Documentation***

Appendix C contains the Serial Protocol documentation for the product described herein, if applicable.



# *Appendix D*

## ***Spare Parts***

Appendix D contains a table of recommended spare parts for on-hand replacement. The following sheet can be copied and used as a fax form to order the required spare parts. Please make sure to include all identifying information to facilitate the processing of your order. The order may also be sent via email or regular mail delivery, at the following address.

**Mitec Telecom Inc.**

9000 Trans Canada Blvd.  
Pointe Claire, Quebec, Canada  
H9R 5Z8

Fax: (514)694-3814  
Email: [rmitch@Mitetelecom.com](mailto:rmitch@Mitetelecom.com)

For additional information, please contact our customer service department at:  
(514)694-9000 or 1-800-724-3911



**Mitec telecom inc.**

*designers and manufacturers of telecom & wireless products  
ISO 9001 Certified*



***Spare Parts Order Form***

**WTX-14014539\_40\_41-70-ES-xx  
High Power Transmitter Module**

**From:**

**Place By:**

**Signature:**

**Telephone:**

**Fax**

**Email:**

**Part Description**

**Part Number**

**Quantity**

**Unit Price\***

**Line Total\***

\* To be completed by **Mitec** Sales Department

**Fax to: Customer Service (514)694-3814**