

# INSTALLATION AND OPERATING MANUAL

98/OSM/0019  
ISSUE 1  
13/04/99

## DCS 1800 / PCS 1900 BOOSTER SYSTEM INSTALLATION AND OPERATING MANUAL



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Reference; 98/OSM/0019

Issue: 1

Date: 13/04/99

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## 1. Introduction

Airtech produce a range of masthead amplifier and associated equipment to provide enhancement of the performance of PCS, PCN, and GSM Base-stations (BTS ).

The limitation of the BTS has traditionally been its sensitivity to the Uplink, or received signal at the BTS. The antenna receives the signal from the mobile, but this can be degraded by the feeder cable losses from the antenna down the mast to the BTS. The Airtech Masthead Amplifier employs a low noise amplifier to transmit the improved signal strength down to the BTS overcoming the signal degradation due to the feeder cable losses.

The result is a greater sensitivity of the receive system, providing better quality, greater coverage and generally fewer dropped calls, as well as reducing the power required by the mobile phone from any particular location which may increase the battery life and general user satisfaction with the network.

The Airtech Booster is designed to increase the downlink signal level by placing the high power amplifiers at the masthead reducing the feeder losses. This extends the range of the base station further, reducing infrastructure costs or improving coverage in black spots.

### **CAUTION:**

**PRIOR TO WORKING ON OR INSTALLING THE BOOSTER SYSTEM OR ANY OF ITS COMPONENTS, ENSURE THAT THE BTS TRANSMITTER RF OUTPUT IS TURNED OFF AND THAT PRECAUTIONS ARE TAKEN TO ENSURE THAT THE TRANSMITTER CANNOT BE ACTIVATED DURING THE EQUIPMENT INSTALLATION.**

**THERE ARE NO USER SERVICABLE COMPONENTS INSIDE THE BOOSTER. RETURN THE UNIT TO THE FACTORY IF SERVICE OR REPAIR IS REQUIRED.**

## 2. Technical Description of Booster System Equipment

The booster system consists of the following units:

- Booster
- Booster Bias Tee
- Variable Gain G3 Masthead Amplifier (Optional)
- Variable Gain Masthead Amplifier Compatible Bias Tee (Optional)
- Booster System Power Distribution Unit
- Connecting Cables

### 2.1 *Booster*

The Booster is designed for masthead operation. It includes a variable gain transmit high power amplifier and a variable high gain LNA. The gain settings are controlled by a micro-controller via a serial data link with the Power Distribution Unit.

The Booster is designed to interface with duplexing feeds to both the antenna and the Base Station. The RF, DC power (+30V ) and serial data link are all fed to the booster through the RF coaxial feeder cable.

The Booster is housed in a weatherproofed enclosure rated to IP68, with a 7/16 RF connector for the ANT at the top and a 7/16 RF connector for the BTS at the base. There is also a grounding stud mounted on the base used for grounding the Booster to the mast, and provides the discharge path for the lightning protection circuit.

### 2.2 *Booster Bias Tee*

The Booster Bias Tee performs four functions within the booster system. A straight through path is provided for RF signals, the DC power from the PDU is injected onto the feeder and the serial communications to/from the booster is taken from the feeder and supplied to the PDU. The Bias Tee also provides lightning protection for the BTS and PDU.

### 2.3 *Variable Gain G3 Masthead Amplifier*

The Airtech Variable Gain G3 MHA M-series single feeder is designed to deliver up to 22dB Rx gain, low Tx loss and low Rx noise figure in a compact low volume and light weight IP68 enclosure. The MHA-M series single feeder is designed to interface with duplexing feeds to both the antenna and the Base Station.

The MHA is housed in a weatherproofed enclosure, with a 7/16 RF connector for the ANT at the top and a 7/16 RF connector for the BTS at the base. There is also a grounding stud mounted on the base used for grounding the MHA to the mast, and provides the discharge path for the lightning protection circuit of the MHA.

The Variable Gain G3 unit requires a +12V supply from the power distribution unit (PDU) at the base station. This is supplied to the G3 MHA via the RF coaxial feeder cable.

## **2.4 Variable Gain G3 MHA Bias Tee**

The Variable Gain G3 MHA Bias Tee performs the same functions as the Booster bias tee although it is not capable of handling the current requirements of the booster. The Variable Gain G3 MHA Bias Tee uses one connector for both the DC power and the serial communications. A standard G3 Bias Tee should not be used in conjunction with the Variable Gain G3 MHA since it will block the serial communication interface with the PDU.

## **2.5 Power Distribution Unit**

The Power Distribution Unit (PDU) converts the input supply to the +30V DC for the Boosters and the +12V DC for the MHAs. The PDU also generates an internal +5V DC supply used to drive the control and status panel integrated into the PDU. The PDU can supply, control and display the status of three boosters and six Variable Gain G3 MHAs. The PDU reports the status of up to three Boosters and six Masthead Amplifiers and can also set the Tx and Rx gains for each sector independently. The Booster PDU is only designed to be used in conjunction with the Variable Gain G3 MHA.

It is important to ensure that the base station supply is within the voltage limits required by the Booster PDU and that it is capable of providing the power. The power requirements can be calculated using the table below.

<b>Supply Voltage Limits</b>	
AC Input Option	85 $V_{rms}$ to 264 $V_{rms}$ - 47Hz to 63Hz
DC Input Option	-36V to -72V

<b>Power Supply Requirements</b>	<b>AC Option</b>	<b>DC Option</b>
Per Booster	300W	250W
Per Masthead Amplifier	5W	5W

## **2.6 Cables**

The following three cables are required in order to connect the booster system:

- PDU to BTS -48V DC supply ( DC input PDU only )
- PDU to Booster Bias Tee DC supply
- PDU to Booster Bias Tee ( Serial Data )
- PDU to MHA Bias Tee

In addition to these supplied cables, a number of RF jumper cables will be required to connect the booster to the antenna and BTS to the Bias Tee.

## 3. Interface Details

### 3.1 *Booster*

The Booster is provided with the following electrical interfaces:

*7/16 DIN Female (BTS) on the base.* This is the connection for the duplexed Tx/Rx signals to/from the BTS. As well as providing for RF transmission, this connector also provides for DC feed and the communication interface via the RF cable and Bias Tee assembly.

*7/16 DIN Female (ANT) on the top.* This is the connection for the Tx/Rx Antenna. This port should be as close as possible to the antenna with the shortest/lowest loss interconnecting cable practicable.

*M8 Ground Stud on the base.* This provides the Primary Lightning protection ground to the Booster. The ground cable should be of the largest cross sectional area, shortest length practicable and be connected to a suitable grounding point on the mast structure.

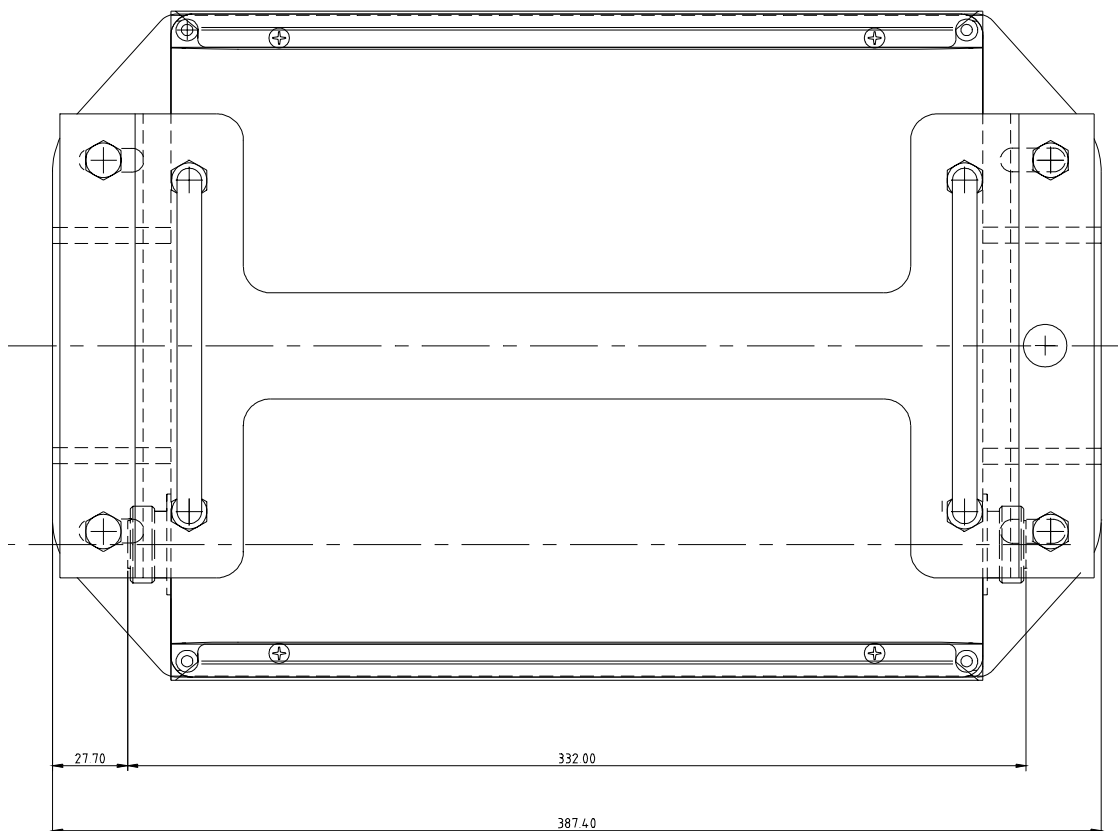


Figure 1 Interface Drawing for the Booster

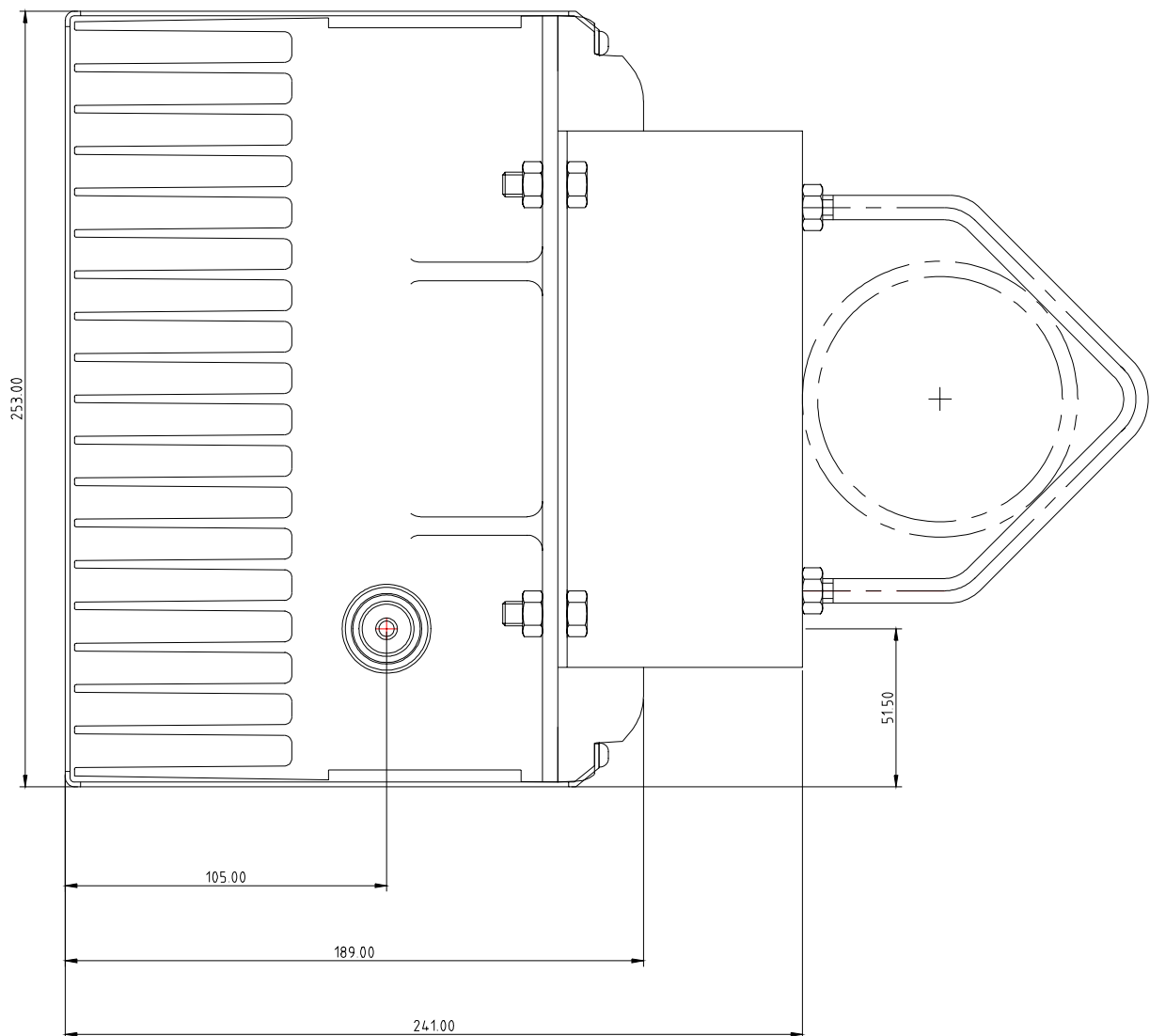


Figure 2 Interface Drawing for the Booster

### 3.2 **Booster Bias Tee**

The Booster Bias Tee is provided with the following electrical interfaces.

*7/16 DIN Female (Antenna Port).* This is the connection for RF feeder up the mast to the Booster and Antenna. As well as providing for the RF receive and transmit signal, this connector also provides for DC feed and the communication interface via the centre pin of the 7/16" connector. It is labelled **ANT**.

*7/16 DIN Male (BTS Port).* This is the connection for RF jumper from the Base-station Transceiver. It is labelled **BTS**.



*SMA Female.* This is the connector for the serial communications interface from the Airtech Booster System PDU. It is labelled **COMMS**.

*MIL 5015 10SL4-PSN DC Power Connector.* This is the connector for the DC power input from the Airtech Booster System PDU via a cable supplied by Airtech. The B pin on the connector has the 30VDC supply. It is labelled **DC**.

*M6 Ground Stud.* This provides the Primary Lightning protection ground to the Bias Tee. The ground cable should be of the largest cross sectional area, shortest length practicable and be connected to a suitable grounding point. Failure to connect this to an adequate Ground may result in damage to the Booster System components in the event of high EMFs being generated in the RF Feeder line during lightning strikes.

The specification of the sex and type of the RF connectors can be altered by special request. Please contact Airtech for further details if this is required.

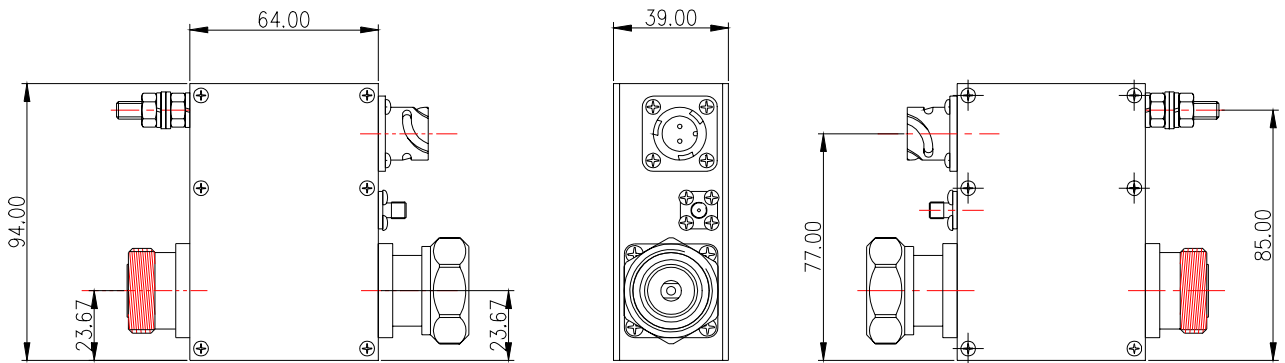
### **3.3 Variable Gain G3 Masthead Amplifier**

The MHA is provided with the following electrical interfaces:

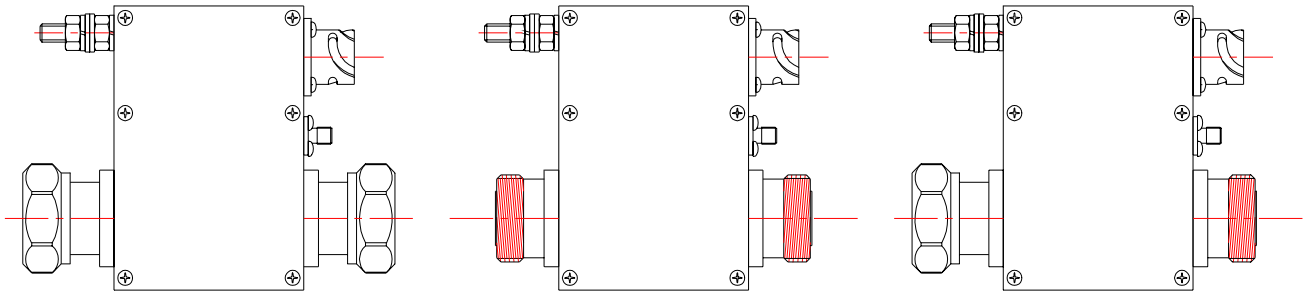
*7/16 DIN Female (BTS) on the base.* This is the connection for the duplexed Tx/Rx signals to/from the BTS. As well as providing for RF transmission, this connector also provides for DC feed and the communication interface via the RF cable and Bias Tee assembly.

*7/16 DIN Female (ANT) on the top.* This is the connection for the Tx/Rx Antenna. This port should be as close as possible to the antenna with the shortest/lowest loss interconnecting cable practicable.

*M8 Ground Stud on the base.* This provides the Primary Lightning protection ground to the MHA. The ground cable should be of the largest cross sectional area, shortest length practicable and be connected to a suitable grounding point on the mast structure.



## Interface Drawing



## Connector Options

Figure 3 Interface Drawing for the Booster External Bias Tee

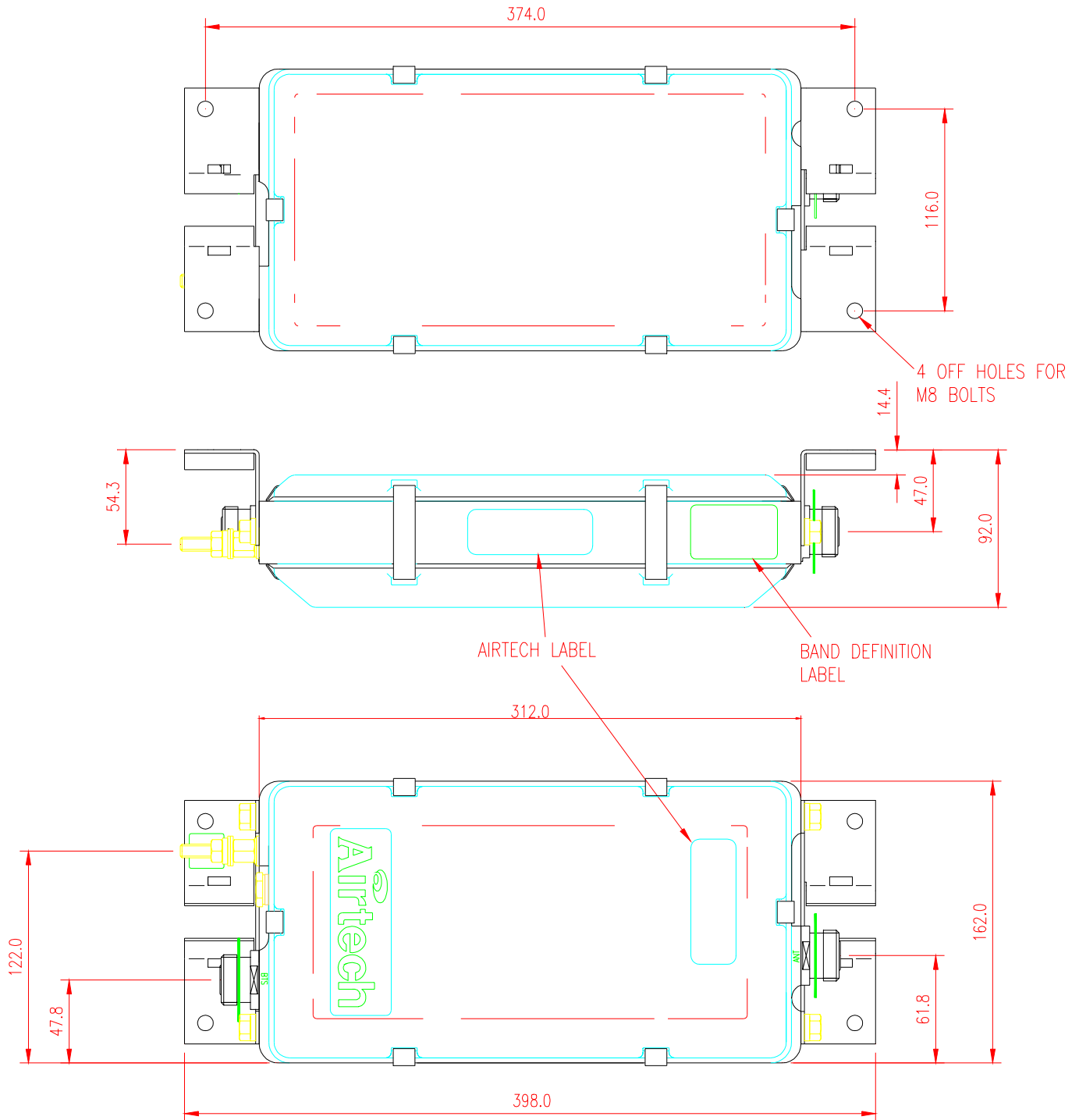


Figure 4 Interface Drawing for the Variable Gain G3 MHA

### **3.4 Variable Gain G3 Bias Tee**

The Bias Tee is provided with the following electrical interfaces:

7/16 DIN Female (Antenna Port). This is the connection for RF feeder up the mast to the MHA and antenna. As well as providing for the RF receive and transmit signal, this connector also provides for DC feed and the communication interface via the centre pin of the 7/16" connector. It is labelled **MHA**.

7/16 DIN Male (BTS Port). This is the connection for RF jumper from the BTS. It is labelled **BTS**.

SMA DC Power Connector. This is the connector for the DC power input from the Airtech PDU via a cable supplied by Airtech. This connector has the MHA supply and communications interface on the centre pin of this co-axial connector.

M6 Ground Stud. This provides the Primary Lightning protection ground to the Bias Tee. The ground cable should be of the largest cross sectional area, shortest length practicable and be connected to a suitable grounding point. Failure to connect this to an adequate Ground may result in damage to the Bias Tee in the event of high EMFs being generated in the RF Feeder line during lightning strikes.

The specification of the sex and type of the RF and DC connectors can be altered by special request. Please contact Airtech for further details if this is required.

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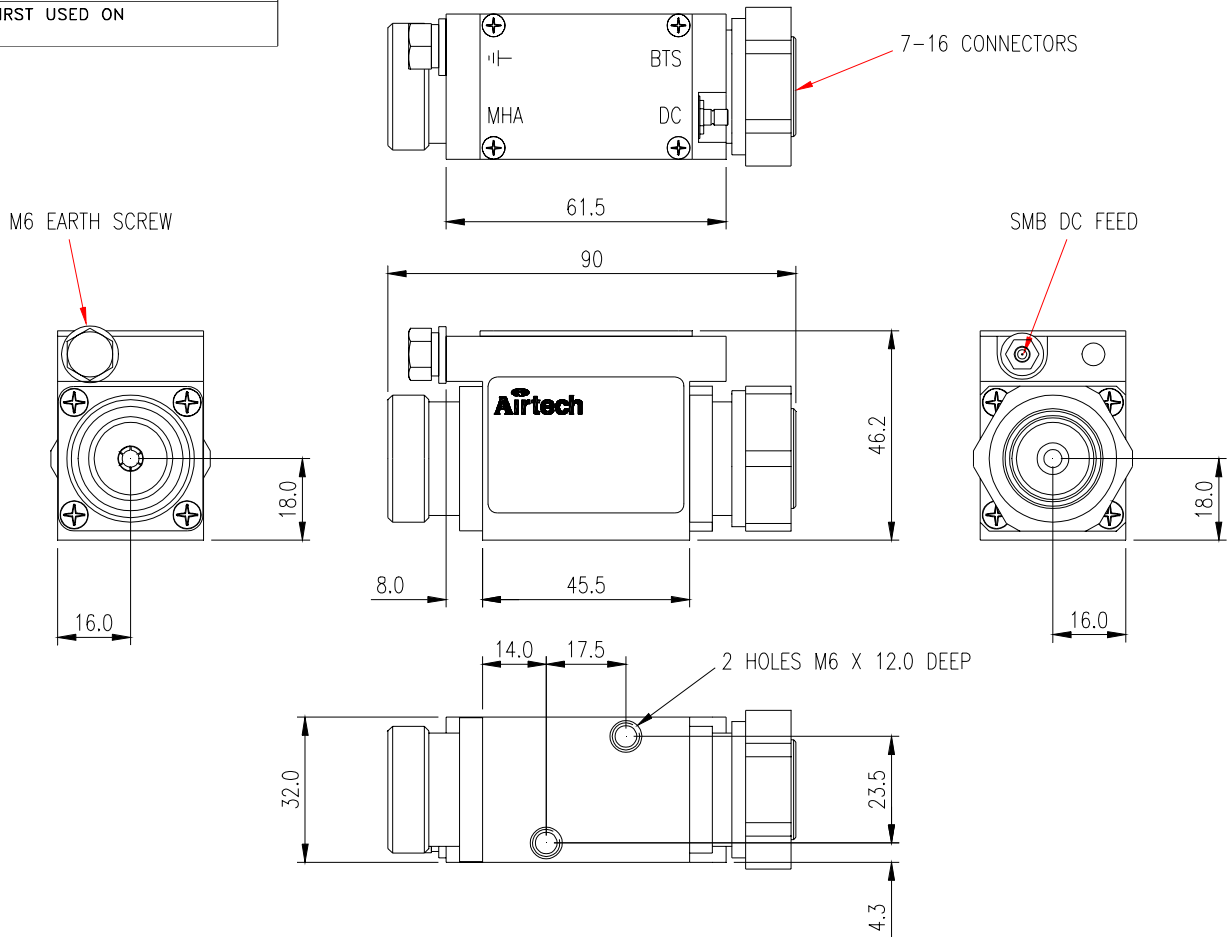


Figure 5 Interface Drawing for the Indoor Variable Gain MHA Bias Tee

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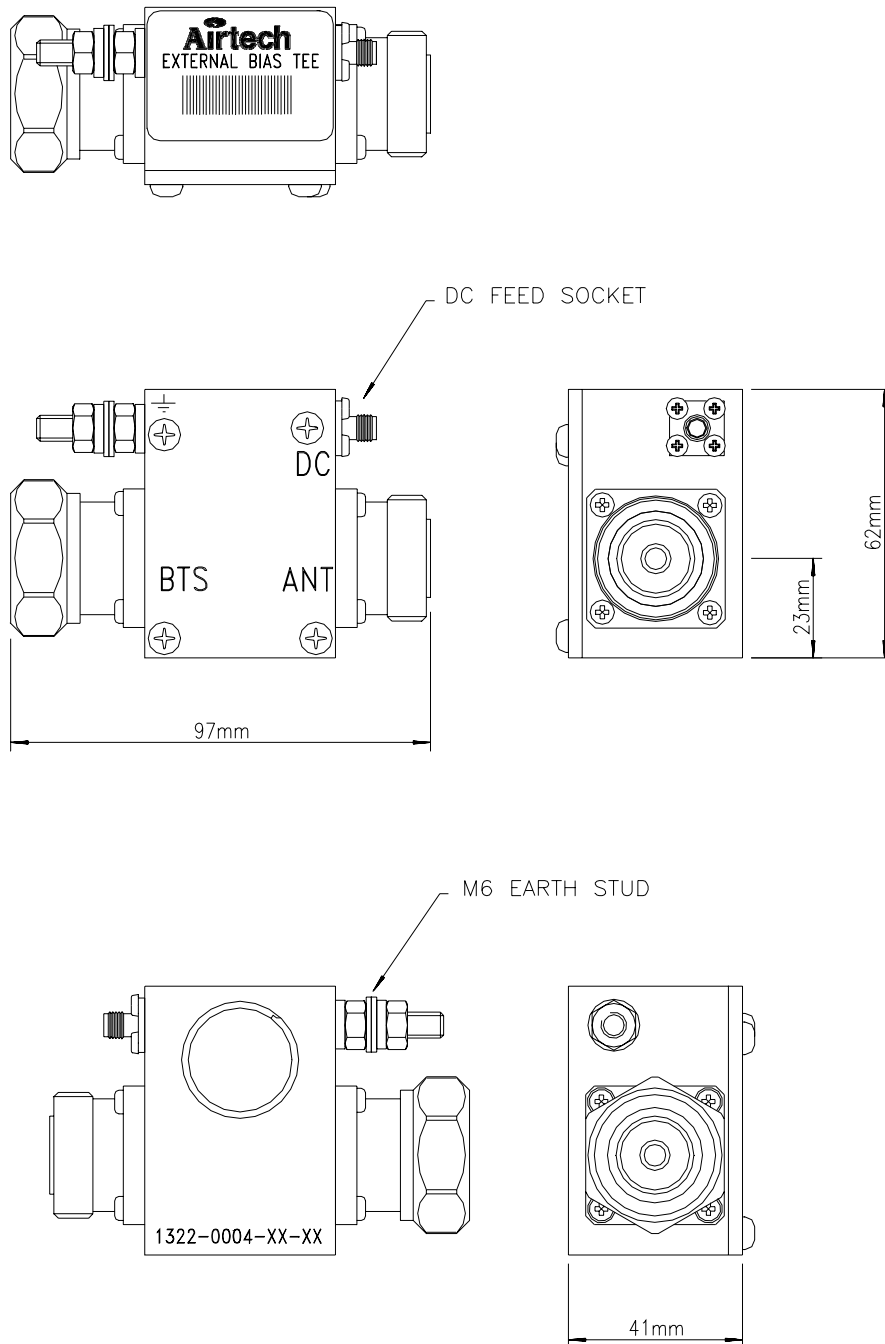


Figure 6 Interface Drawing for the Outdoor Variable Gain MHA Bias Tee

## 3.5 Power Distribution Unit

The Booster Power Distribution Unit is provided with the following electrical interfaces:

### 3.5.1 Supply Input Connector

#### 3.5.1.1 AC Input Option.

Connector block for single phase mains.

Colour	Connection
BLUE	Neutral
BROWN	Live
YELLOW/GREEN	Earth

#### 3.5.1.2 DC Input Option.

This MIL\_C\_5015 20-19P input connector is used to supply the -48V DC required by the PDU.

Pin	Connection
A	No Connection
B	0V
C	-48V

### 3.5.2 PDU to Bias Tee Connectors

MIL-C-5015 16-11S booster power connectors. This connector supplies the +30V to the booster through the Bias Tee.

Pin	Connection
A	+30V
B	No Connection
C	0V

The TNC female booster communications connectors provides the serial communication interface to the booster through the booster bias tee.

The TNC female MHA connector provides the +12V supply and the serial communication interface to the variable gain G3 through the bias tee.

### 3.5.3 Alarm Output Connector

The weatherproof 9-Way D-Type plug provides the booster system summary alarm interface to the BTS. There are two options for the alarm interface:

Option 1.	TTL	Logic High = Operational	Logic Low = Fault
Option 2.	Relay Contacts	Closed = Operational	Open = Fault

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<i>Pin</i>	<i>Colour</i>	<i>TTL Option</i>	<i>Relay Option</i>
1	Brown	Sector 1 Booster	Sector 1 Booster
2	Red	Sector 2 Booster	Sector 2 Booster
3	Orange	Sector 3 Booster	Sector 3 Booster
4	Yellow	M-MHAs	M-MHAs
5	Green	D-MHAs	D-MHAs
6	Blue	Summary	Summary
7	Violet	not used	not used
8	Grey	not used	not used
9	White	0V	Common



### 3.5.4 M8 Ground Stud

This provides the Primary Lightning protection ground to the Power Distribution Unit. The ground cable should be of the largest cross sectional area, shortest length practicable and be connected to a suitable grounding point on the BTS Ground loop. Failure to connect this to an adequate Ground may result in damage to the PDU in the event of high EMFs being generated in the supply cables during a lightning strike.

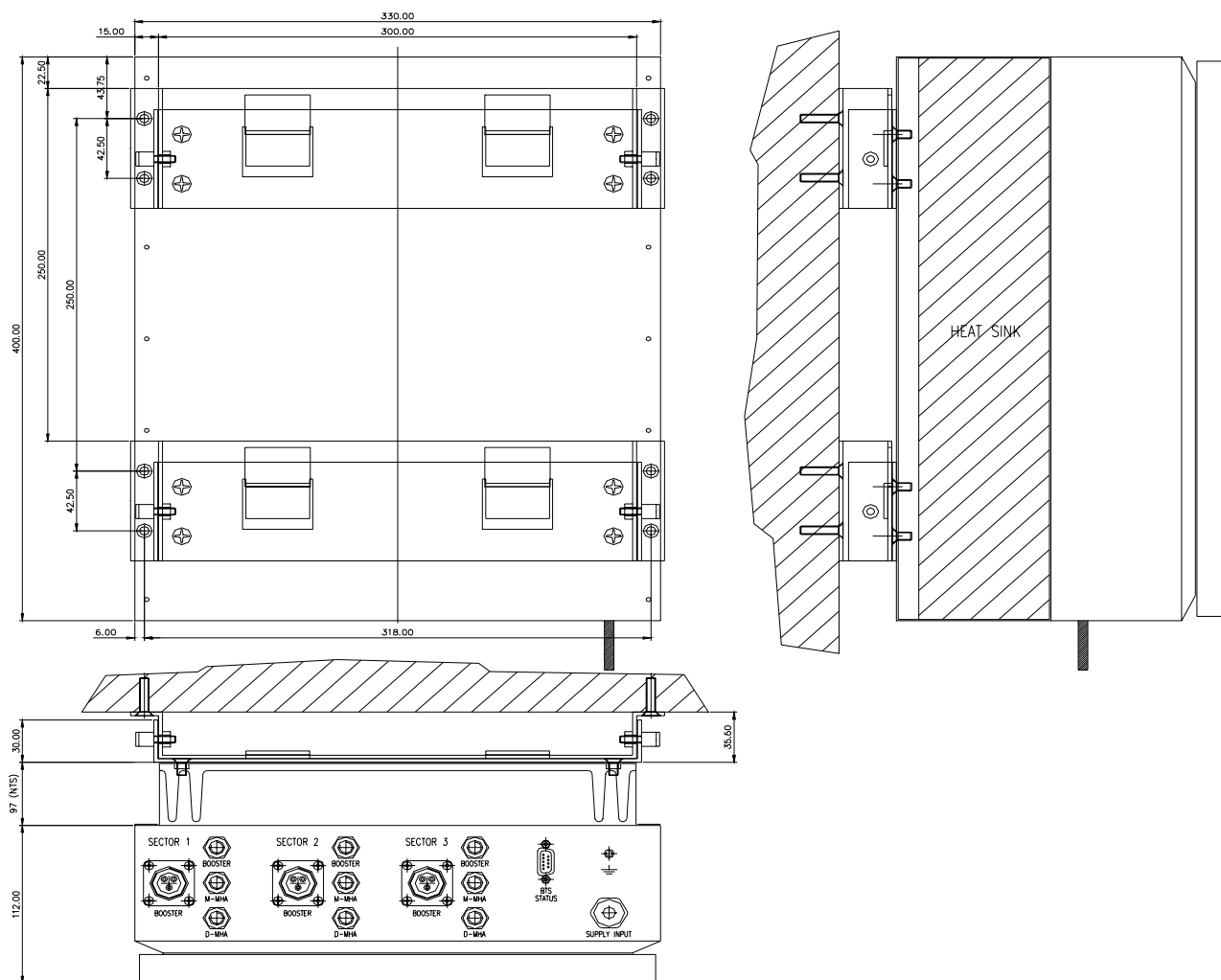


Figure 7 Interface Drawing for the PDU with Wall Mounted Bracket

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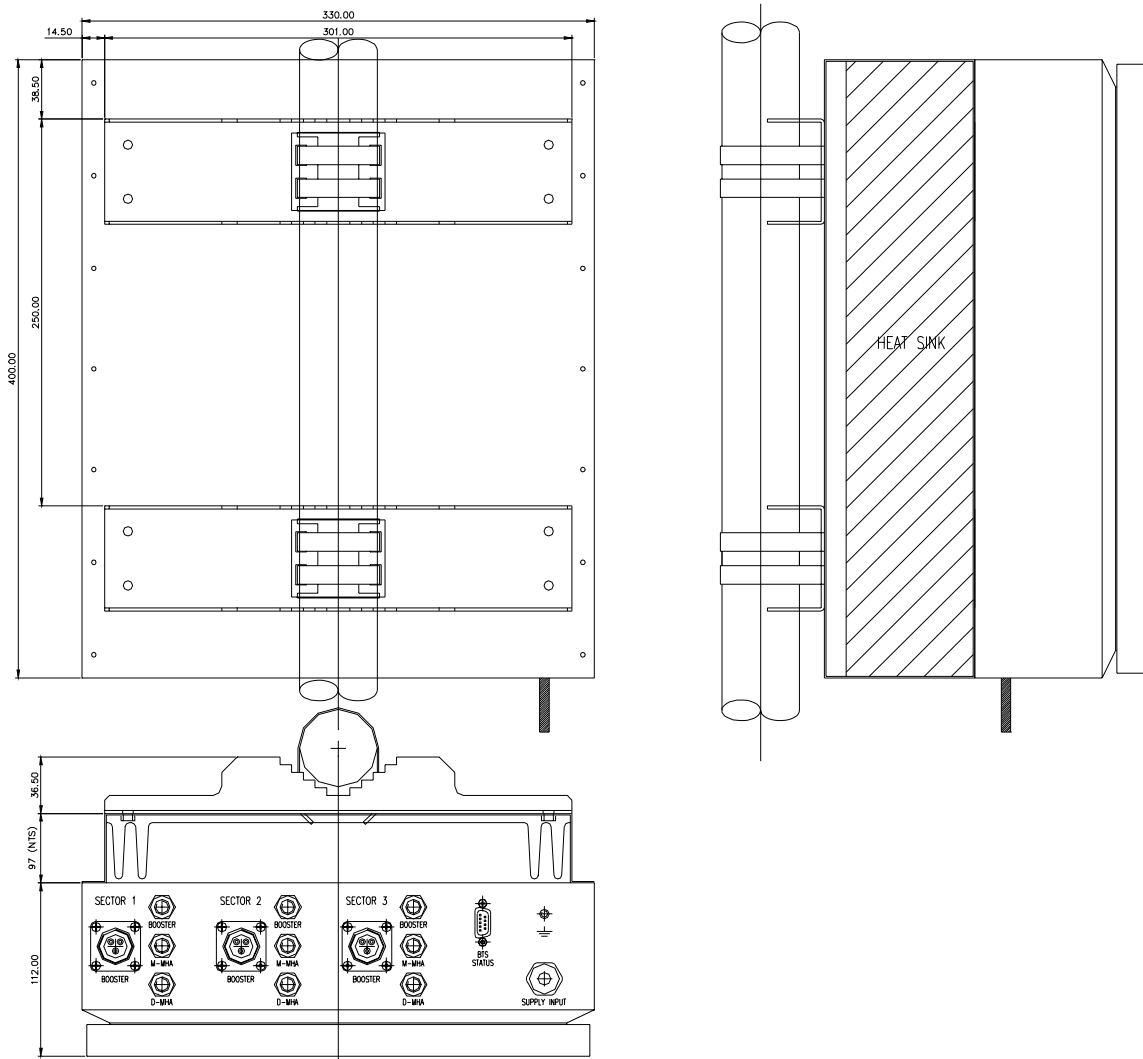


Figure 8 Interface Drawing for the PDU with Pole Mounted Bracket

## 4. Installation of the Booster System

The Booster System connectivity for three sector configuration is shown in Figure 9. Each sector consists of one Booster for main transmit and receive signals and one Masthead Amplifier for diversity receive signal. The diversity MHA shown in the diagram is a standard variable high gain dual duplexed MHA. The transmit section of the MHA when used in the diversity path is not used. Some systems may have two diversity MHAs for each sector (total of six for a three sector site). The PDU shown in the diagram has a capability of providing power to three Boosters and six MHAs although connections to only three MHAs are shown in the diagram.

**CAUTION:**  
**PRIOR TO INSTALLING THE BOOSTER SYSTEM OR ANY OF ITS COMPONENTS, ENSURE THAT THE BTS TRANSMITTER OUTPUT IS TURNED OFF AND THAT PRECAUTIONS ARE TAKEN TO ENSURE THAT THE TRANSMITTER CANNOT BE ACTIVATED DURING THE EQUIPMENT INSTALLATION.**

### 4.1 *Booster*

Prior to installing the booster assembly ensure that there is sufficient space available for the mounting of the equipment to the mast pole or to the wall structure. This clearance should include access for cable bend radius and termination of the feeder.

The booster is attached to the antenna pole by the use of two jaw clamp assemblies which are fitted to the upper and lower mounting brackets.

*The booster must be fitted vertically with the BTS feeder connector to the underside of the equipment and the antenna port at the top. Only this arrangement will provide the correct convection cooling required by the design.*

Connect the booster Ground stud to the antenna Ground arrangement using a cable of at least 24 mm<sup>2</sup> cross-sectional area. The booster is connected to the cable using a 8 mm grounding stud. Ensure that the torque applied to the booster ground stud nut does not exceed 10 Nm.

Connect the BTS feeder jumper cable from the main feeder to the BTS port at the lower end of the booster and the Antenna jumper cable to the upper end of the booster. Ensure that the connectors are correctly mated then tighten the connector to 20 - 25 Nm using a torque spanner. Ensure that the bend radii of the cable is not placing sideways stress on the cable or connectors.

**DO NOT CONNECT THE RF FEEDER CABLE FROM THE BTS DIRECTLY TO THE BOOSTER. ALWAYS USE A JUMPER TO PREVENT SIDELOADS ON THE CONNECTORS.**

Once the connectors are correctly tightened onto to the Booster both of the cable ports should be sealed using the heat-shrink sleeves.

Ensure that any excess cable is securely attached to the mast to prevent movement.

## **4.2 *Booster Bias Tee***

Ensure the BTS is turned off and all transmitters inhibited. Remove the antenna feeder cables from the existing antenna output connectors (on top of the BTS cabinet) ensuring that each cable assembly is identified with its mating location. Note: loosen the cable support clamps where necessary to provide movement of cables

Attach a Booster Bias Tee assembly to each of the antenna outputs on the top of the BTS cabinet and tighten each connector to 20 - 25 Nm using a torque spanner, whilst ensuring a counter torque is applied to the connector body.

Connect each Bias Tee Ground stud to the cabinet primary Ground using a short length of 10 mm<sup>2</sup> earth cable. This should be terminated in an M6 tag for connection to the Bias Tee assembly, ensuring that the Ground stud nut is tightened to not greater than 4 Nm.

The external antenna feeder cables should be re-connected to the Booster Bias Tees, ensuring that each antenna is connected to its original BTS output port, and tightened to 20 - 25 Nm torque, whilst ensuring a counter torque is applied to the connector body. Retighten the cable support clamps where necessary to secure the cables

## **4.3 *Masthead Amplifier***

Prior to installing the MHA assembly ensure that there is sufficient space available for the mounting of the equipment to the mast pole or to the wall structure. This clearance should include access for cable bend radius and termination of the feeder.

The MHA is attached to the antenna pole by the use of the two adjustable strap assemblies which are fitted to the upper and lower mounting brackets. Thread each of the strap assemblies through the two slots provided in the mounting brackets. Wrap the straps around the mounting pole and locate into the worm drive screw assembly. The two screw assemblies should then be adjusted using a 8 mm open ended spanner or socket assembly, ensuring that the torque applied to the screw does not exceed 2 Nm.

The MHA should be fitted vertically with the BTS feeder connector to the underside of the equipment and the antenna port at the top.

Connect the MHA Ground stud to the antenna Ground arrangement using a cable of at least 24 mm<sup>2</sup> cross-sectional area. The MHA is connected to the cable using a 8 mm grounding stud. Ensure that the torque applied to the MHA ground stud nut does not exceed 10 Nm.

Connect the jumper from the output connector of the antenna to the port labeled ANT on the top of the MHA. Ensure that the connectors are correctly mated then tighten the connector to 20 - 25 Nm using a torque spanner. Ensure that the bend radii of the cable is not placing sideways stress on the cable or connectors.

Connect the BTS feeder jumper cable from the main feeder to the BTS port at the lower end of the MHA. Ensure that the connectors are correctly mated then tighten the connector to 20 - 25 Nm using a torque spanner. Ensure that the bend radii of the cable is not placing sideways stress on the cable or connectors.

**DO NOT CONNECT THE RF FEEDER CABLE FROM THE BTS DIRECTLY TO THE MHA. ALWAYS USE A JUMPER TO PREVENT SIDELOADS ON THE CONNECTORS.**

Once the connectors are correctly tightened onto to the MHA both of the cable ports should be sealed using the heat-shrink sleeves.

Ensure that any excess cable is securely attached to the mast to prevent movement.

#### **4.4 G3 MHA Bias Tee**

Ensure the BTS is turned off and all transmitters inhibited. Remove the antenna feeder cables from the existing antenna output connectors (on top of the BTS cabinet) ensuring that each cable assembly is identified with its mating location. Note: loosen the cable support clamps where necessary to provide movement of cables

Attach a Variable Gain MHA Bias Tee assembly to each of the antenna outputs on the top of the BTS cabinet and tighten each connector to 20 - 25 Nm using a torque spanner, whilst ensuring a counter torque is applied to the connector body.

Connect each Bias Tee Ground stud to the cabinet primary Ground using a short length of 10 mm<sup>2</sup> earth cable. This should be terminated in an M6 tag for connection to the Bias Tee assembly, ensuring that the Ground stud nut is tightened to not greater than 4 Nm.

The external antenna feeder cables should be re-connected to the Bias Tees, ensuring that each antenna is connected to its original BTS output port, and tightened to 20 - 25 Nm torque, whilst ensuring a counter torque is applied to the connector body. Retighten the cable support clamps where necessary to secure the cables

## **4.5 Power Distribution Unit**

Locate a suitable position for the installation of the PDU. Ensure that there is adequate air flow around the heatsink.

Install the PDU using the supplied brackets mounting the unit vertically with the connectors at the bottom.

Connect the PDU Ground stud to the primary Ground using a short length of 10 mm<sup>2</sup> earth cable. This should be terminated in an M8 tag for connection to the PDU assembly, ensuring that the Ground stud nut is tightened to not greater than 10 Nm.

## **4.6 Electrical Installation**

1. Ensure that the PDU circuit supply breaker is turned off at the distribution board.  
Connect the PDU input cable from the distribution board to the PDU supply input.  
Ensure that the connector is securely mated.
2. Connect the Booster DC Output cables between the PDU and the Booster Bias Tee.
3. Fit the Booster Communication cables between the PDU and the Booster Bias Tee.
4. Fit the MHA Cables between the PDU and the Variable Gain G3 compatible Bias Tee.
5. Connect the Alarm cable if required.

Note: Only use cable assemblies supplies by Airtech.

## BOOSTER SYSTEM CONNECTIVITY

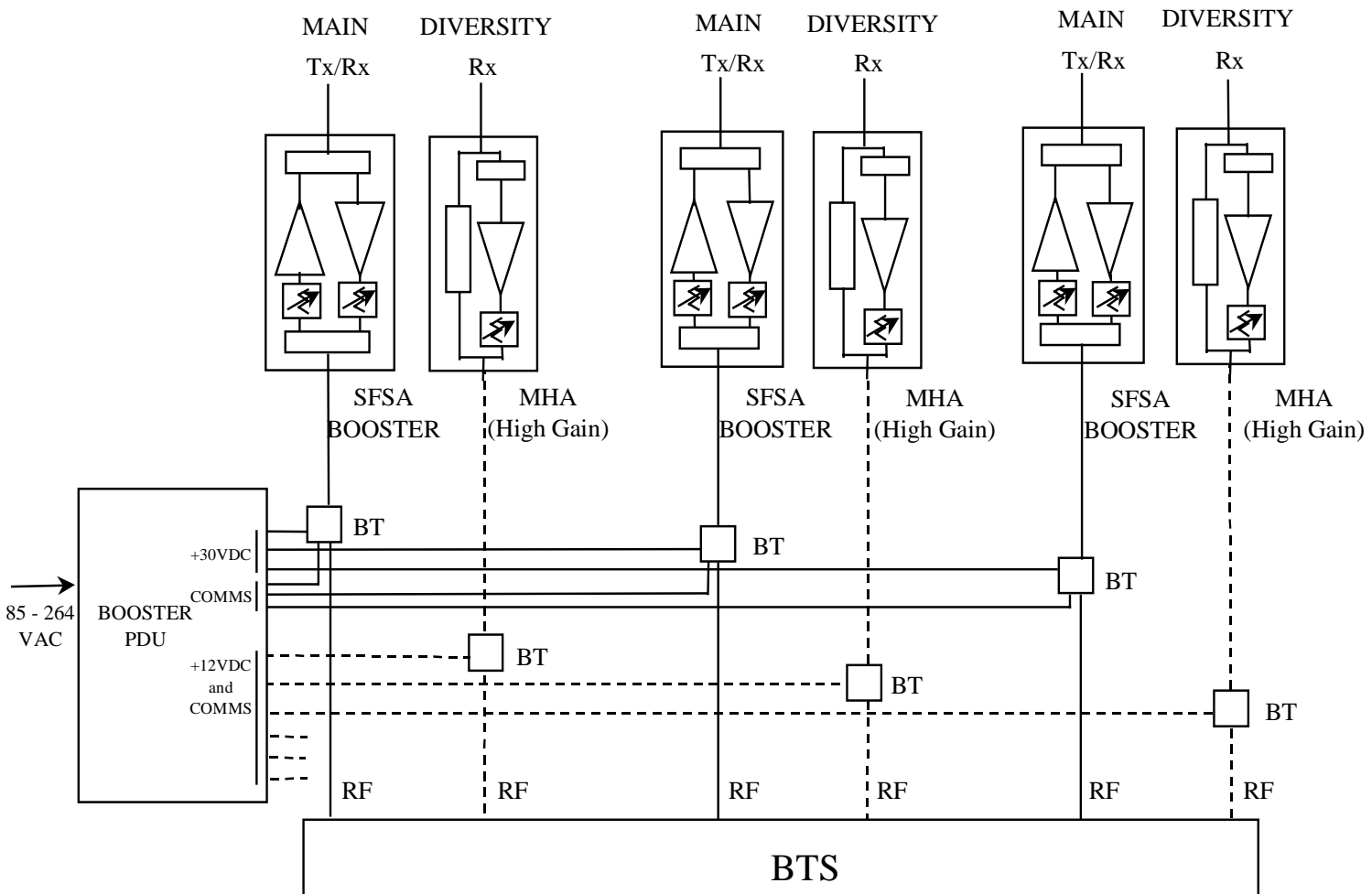


Figure 9 Booster System Connectivity

## 5. Commissioning

### 5.1 Switch On

Ensure that the circuit breakers inside the Booster PDU are in the open position. Ensure that the BTS transmitter output is turned off. Enable the supply to the PDU at the BBU distribution board.

Enable the sector 1 circuit breaker within the Booster PDU. All the status LEDs for the installed equipment on sector 1 should be green. If this is not the case check that everything has been connected properly. If there are no obvious causes contact Airtech for technical support.

Enable sector 2 and sector 3. Ensure that all the appropriate LEDs are green.

### 5.2 Status

LED Label	Description	Conditions
COMMs	Booster communication link	Green = Good
COMMs		Red = Fail
POWER	PDU Power	Green = Good Red = Fail
VSWR	Booster Output VSWR	Green = Good Red = Fail Off = Booster Comms Failure/Booster not fitted
CURRENT	Booster under current	Green = Good Red = Fail Off = Booster Comms Failure/Booster not fitted
VOLTAGE	Booster under voltage	Green = Good Red = Fail Off = Booster Comms Failure/Booster not fitted
NOT USED		
HPA TEMP	Booster HPA Over Temperature	Green = Good Red = Fail Off = Booster Comms Failure/Booster not fitted
M-MHA SOFT FAIL	M-MHA soft fail	Green = Good Red = Fail Off = M-MHA Comms Failure/MHA not fitted
M-MHA HARD FAIL	M-MHA hard fail	Green = Good Red = Fail Off = M-MHA Comms Failure/MHA not fitted
D-MHA SOFT FAIL	D-MHA soft fail	Green = Good Red = Fail Off = D-MHA Comms Failure/MHA not fitted
D-MHA HARD FAIL	D-MHA hard fail	Green = Good Red = Fail Off = D-MHA Comms Failure/MHA not fitted



### **5.3 Attenuator Settings**

The HPA attenuator switch sets the transmit gain. The gain will be a maximum 12dB at the "0" switch setting. The switches cover an attenuation range of 16dB ( 0 to F in hexadecimal ) in 1dB steps.

The LNA attenuator sets the receive gain in the booster and the MHAs with a maximum of 22dB at the "0" switch setting. The switches cover an attenuation range of 16dB ( 0 to F in hexadecimal ) in 1dB steps.

The voltage adjust switch is no longer required and has been disabled.

The transmit amplifier provides a maximum RF output power level of 20 watts (+43dBm) and a nominal maximum gain of 12dB. It is essential that the gain of the booster is adjusted to ensure that the output power does not exceed this level. The following procedure may be used to this end.

1. Set the booster transmit attenuation to 15dB by setting the rotary switch on the control panel to F.
2. Enable the BTS Tx carrier output at the required operating power level.
3. Whilst monitoring the booster output power using a suitable power meter gradually decrease the Tx attenuation until the booster output power reaches the required level (not exceeding 20W).

The booster system is now ready for performance testing.