Ku-Band Matchbox Block Upconverters
8 W / 12 W /16 W / 25 W / 40 W

Operation Manual

WAVESTREAM Corporation

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Conventions

⚠	**⚠ D A N G E R**
	Hazard.
	Immediate hazard, which if not avoided WILL result in severe injury or death to personnel or destruction of the equipment.

⚠	**⚠ W A R N I N G**
	Hazard.
	Potentially immediate hazard, which COULD result in severe injury or death to personnel or destruction of the equipment.

⚠	**⚠ C A U T I O N**
	Hazard.
	Immediate hazards, which COULD result in minor or moderate injury to personnel or damage to the equipment. Also indicates unsafe practices.

🗒	**N o t e**
	Items that are important for safe and correct equipment operation.

Proposition 65 Warning

⚠	**⚠ W A R N I N G**
	This product contains chemicals known to the State of California to cause cancer and/or birth defects or other reproductive harm.

Technical Support

Contact Technical Support via email at support@wavestream.com.

Notices

The information supplied in this Operation Manual is provided by Wavestream Corporation as a service to customers. Although every effort has been made to verify the completeness and accuracy of the information contained in this manual, due to the highly technical nature of the material, and the dynamic nature of satellite communications, Wavestream cannot be responsible for any errors or omissions.

Warranty

The Wavestream Corporation Warranty is defined in the TERMS AND CONDITIONS OF SALE that accompanied the quotation and purchase order. To return the unit to Wavestream for repair, contact your customer service representative at Wavestream Corporation. If the unit was purchased from a distributor follow the distributor's RMA process.

Always include the Model Number or Serial Number in all correspondence.

The warranty does not apply to any defect, failure, or damage caused by improper use or inadequate or improper maintenance and care.

Notwithstanding the Warranty defined in the Terms and Conditions of Sale, Wavestream Corporation is not obligated to furnish service under this warranty.

- To repair damage resulting from attempts by personnel (other than Wavestream Corporation's personnel) to repair, or service the product.

- To repair damage or malfunction caused by the use of non-standard ancillary equipment.

- To service a product that has not been previously approved in writing by Wavestream Corporation.

N o t e
Opening or removing any component or sealed area will immediately void the warranty.

Regulatory Compliance

European CE

Compliant — CE Certification is in process. Consult Wavestream for the latest information.

CE Declaration of Conformity

We, Wavestream Corporation, declare under sole responsibility that the unit manufactured for

Wavestream Corporation
545 West Terrace Drive
San Dimas, California 91773

to which this declaration relates, is in conformity with the requirements of the following CE Directives:

Council Directive 89/ 336/ EEC (92/ 31/ EEC)

On the approximation of the laws of the Member States relating to electromagnetic compatibility is based on compliance with the following harmonized standards:

EN 55022 Conducted and Radiated Emissions
EN 61000 Immunity
EN 60950 Safety
EN 61000-3-2 Harmonic Current Emissions

Safety	EN 60950
Electromagnetic Emissions	EN 61000-6-4; test method per EN 55022 class A (for industrial)
Electromagnetic Immunity	EN 61000-4-2, 4-3, 4-6, 4-8, 4-11
Harmonic Current Emissions	EN 61000-3-2

Table of Contents

Introduction

This manual provides operating information for the 8 W, 12 W, 16 W, 25 W, and 40 W MFB and MBB series of Ku-Band Matchbox Block Upconverters (BUCs). RF power is delivered in a small light package which allows placement of the unit directly on the feed of most VSAT antennas.

Ku-Band Block Upconverters (BUCs) are high efficiency solid state power amplifiers. The received L-Band input is transmitted as a Ku-Band output. There are two configurations.

Base Part Number	Description	Versions
Standard	14.0 – 14.5 GHz output 950 – 1450 MHz input	28 VDC 48 VDC
Extended	13.75 – 14.5 GHz output 950 – 1700 MHz input	28 VDC 48 VDC

The unit has a weatherized housing rated for indoor or outdoor use. The input power may be 28 VDC or 48 VDC; an optional AC / DC Converter Power Supply accessory is available.

Options

The table below summarizes the options and accessories available for the Ku-Band BUCs.

	8 W	12 W	16 W	25W	40W
AC / DC Converter Power Supply	X	X	X	X	X
IFL	X	X	X	X	X
Ethernet (fan units only)			X	X	X
RS-232	X	X	X	X	X
RS-485	X	X	X	X	X
Fan			X	X	X
Fanless	X	X	X		

About This Manual

This operation manual provides information and instructions for installation and operation of Wavestream equipment. It should be used by trained field technicians or system engineers responsible for satellite and broadcast networks.

For manual updates contact Wavestream support at www.wavestream.com.

How Deck Amplifiers Work

Wavestream's patented Spatial Power Advantage™ delivers RF power in a small and light package. The Deck Power Amplifier™ is an array of solid-state amplifiers mounted on cards that are stacked in the waveguide enclosure.

Each of these cards is imprinted with small input antennas that receive the input signal through the input waveguide and small output antennas that correspondingly radiate the amplified output signal into the output waveguide.
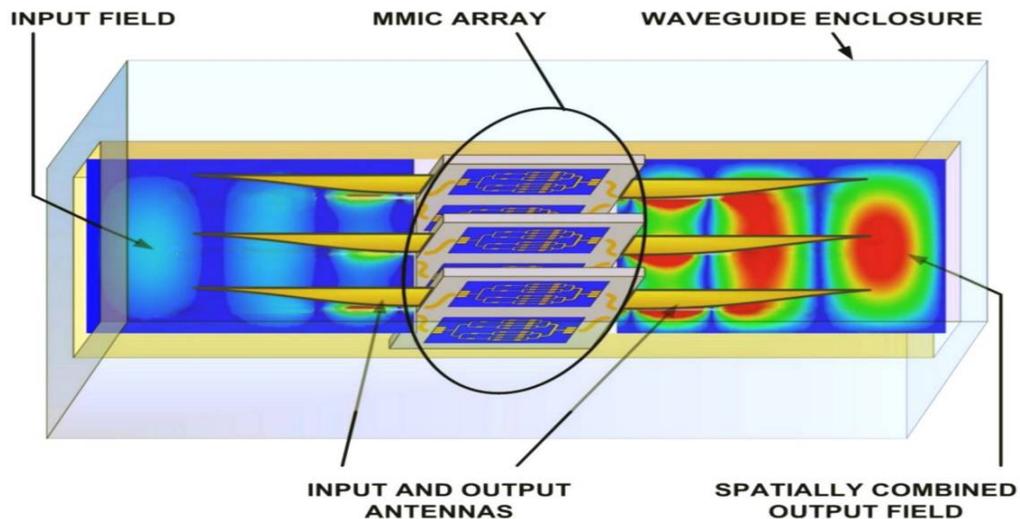
900050043-deckamplifiers

Wavestream's Deck Power Amplifier architecture provides significant advantages over traditional SSPAs which use microstrip or waveguide combining. All of the individual amplifier outputs are spatially combined in a single step into a coherent output beam, making the amplifier highly efficient. The Deck Power Amplifier has combining efficiencies of 85 to 90%, independent of the number of devices to be combined, while traditional SSPA combiners' efficiency degrades with binary increases in the number of amplifier elements.

Wavestream's architecture allows selection of the number of amplifier devices to achieve the optimum operating power without being constrained to binary (power of two) combining.

Safety

The equipment contains delicate electronics and electrical components. Carefully read and follow all safety, use, and operating instructions before operating the equipment. Retain these instructions for future reference.

Safety Precautions

	⚠️ **D A N G E R**
	Shock Hazard.
	Do not open the equipment. High voltages are present inside the unit. Service may only be performed by Wavestream.
	There are no user serviceable parts (except for the external fan, where applicable). Do not attempt to service this product yourself. Any attempt to do so voids any and all warranties.

	⚠️ **W A R N I N G**
	High Power RF Hazard.
	Do not operate unless the RF output waveguide flange is properly connected to the rest of the system or to a high power load.
	The units emit high power RF energy which could be harmful to the human body. When operating the equipment, remove personnel and objects from the front of the unit and near the output waveguide opening.

	⚠️ **W A R N I N G**
	Grounding.
	To protect against voltage surges and built-up static charges, install the unit using appropriate grounding methods in compliance with grounding standards for electrical and radio equipment according to the electrical codes in the country of installation.

	⚠️ **C A U T I O N**
	Electrostatic sensitive.
	There are devices in the unit that are easily damaged by ESD. Take standard ESD precautions.

Operation Precaution

	⚠️ **C A U T I O N**
	Connect to feed and antenna before applying power.
	Do not apply power until the unit is appropriately connected to the feed and antenna system.
	This unit radiates high-energy RF.

Specifications

Performance

	8 W	12 W	16 W	25 W	40 W
P1dB output power	>39 dBm	>40.8 dBm	>42 dBm	>44 dBm	>46 dBm
Rated output power	39 dBm	40.8 dBm	42 dBm	44 dBm	46 dBm
Transmit frequency	Standard: 14.0 – 14.5 GHz Extended: 13.75 – 14.5 GHz				
Input frequency	Standard: 950 – 1450 MHz Extended: 950 - 1700 MHz				
Frequency sense	Non-inverting				
Max. input level w/o damage	+10 dBm max				
Reference signal	Frequency : External 10 MHz Input power : -5 to +5 dBm at input port Phase noise : -125 dBc/Hz max @ 100 Hz -135 dBc/Hz max @ 1 kHz -140 dBc/Hz max @ 10 kHz				
Gain, small signal	68 dB nominal				
Gain adjustment	20 dB, 2 dB steps nominal				
Gain variation over temp at fixed frequency	0.5 dB over 36 MHz 3 dB over 500 MHz				
Gain variation over temp at fixed frequency	±1.5 dB over operating range				
Gain stability, 24 hrs at constant temp/drive	±0.5 dB max				
RF power monitor	15 dB dynamic range from rated power				
Intermodulation	-25 dBc with 2 equal carriers (5 MHz apart) at 3 dB total power backoff from rated power				
Spectral regrowth	-30 dBc at 2 dB below rated power at 1.0x symbol rate offset for OQPSK				
AM/PM conversion	2.0 degree/dB up to rated power -2dB				
Group delay Bandwidth Linear Parabolic Ripple	Any 80 MHz ±0.01 ns/MHz ±0.005 nS/MHz^2 0.5 nS / peak-to-peak				
Phase noise	Meets IESS-308				
Output spurious	-55 dBc maximum				
Transmit band noise power	-73 dBW / 4 kHz maximum				
Receive band noise power	-150 dBW / 4 kHz maximum				

	8 W	12 W	16 W	25 W	40 W
Input VSWR	2:1 maximum				
Output VSWR	1.25:1 maximum				

Prime Power

	8 W	12 W	16 W	25 W	40 W
Prime power					
	80 W @ rated 74 W @ 3 dB OBO	95 W @ rated 85 W @ 3 dB OBO	130 W @ rated 115 W @ 3 dB OBO	205 W @ rated 185 W @ 3 dB OBO	275 W @ rated 240 W @ 3 dB OBO
48 VDC	Min = 36 VDC Max = 60 VDC				
28 VDC	Min = 18 VDC Max = 36 VDC				Min=22 VDC Max=36 VDC
AC option	MBP-000300-XXXX, 90-264 VAC, 50-60Hz				

Environmental

		8 W	12 W	16 W	25 W	40 W
Operating temperature	With fan	-40ºC to +60ºC (-40ºF to +140ºF) ambient air temperature				
	Without fan	-40ºC to +55ºC ambient air temperature				
Relative humidity		100%				
Cooling		Convection (fanless) or forced air (fanned)				
Altitude (above sea level)		Operating: 10,000 ft, above sea level Non-operating: 50,000 ft, above sea level				
Shock & vibration		Non-operating: withstand 20 G at 11 ms ½ sine wave MIL-STD-810E, method 514-4 transportation vibration				
Weatherization		IP-54				

Mechanical

		8 W	12 W	16 W	25 W	40 W
Size	With fan	5.4" W x 4.4" H x 10.3" L (138mm W x 112 mm H x 262 mm L)				
	Without fan	5.4" W x 4.3" H x 9.1" L (138mm W x 109 mm H x 231 mm L)				
Weight	With fan	9.2 lbs (4.2 Kg)				
	Without fan	9.4 lbs (4.3 Kg)				

Options

Select Options When Ordering	8 W	12 W	16 W	25 W	40 W
MFB series – units without a fan	28 or 48 VDC	28 or 48 VDC	28 or 48 VDC	N/A	N/A
MBB series - units with a fan	28 or 48 VDC	28 or 48 VDC	28 or 48 VDC	28 or 48 VDC	28 or 48 VDC
Internal bias-T	Prime power over IFL (optional)				
Monitor and control protocol	RS-232 RS-485 Ethernet (MBB units only)				
M & C connector	32-pin 12-pin				
J3 mating connector	Mating connector to J3, the M&C connector 32-pin: Amphenol P/N: MS3126F18-32S 12-pin: Amphenol P/N: PT06E-14-12S				

Accessories

Specify accessories on the purchase order.

Prime power	AC / DC Converter Power Supply (external)

Equipment

The following equipment, tools, or cables may be shipped with the unit.

- Documentation
- Wavestream CD with computer GUI
- Waveguide gasket: WR75, 1¼" diameter, 1/16" wide (McMaster-Carr P/N: 9557K129)
- AC input cable, where applicable.

Customer Provided Interfaces

The customer must provide the following interface cables and hardware.

- Mounting hardware
- IF IN interface
- RF OUT interface - WR75 waveguide
- Monitor & Control interface

Technical Support

Technical support is available by email at support@wavestream.com.

MFB - Fanless Unit Physical Dimensions

SIDE

M&C SIDE

TOP

IF INPUT CONNECTOR N-TYPE FEMALE

DC & M&C CONNECTOR 32-PIN MALE AMPHENOL #MS3112E18-32P

YELLOW LED (LOSS OF LOCK)

RED LED (SUM FAULT)

2X 1/4-20 UNC ⩔ .30 NEAR & FAR SIDE

2X 1/4-20 UNC ⩔ .70 NEAR & FAR SIDE

2X 1/4-20 UNC ⩔ .27 NEAR & FAR SIDE

4X 6-32 UNC ⩔ .275
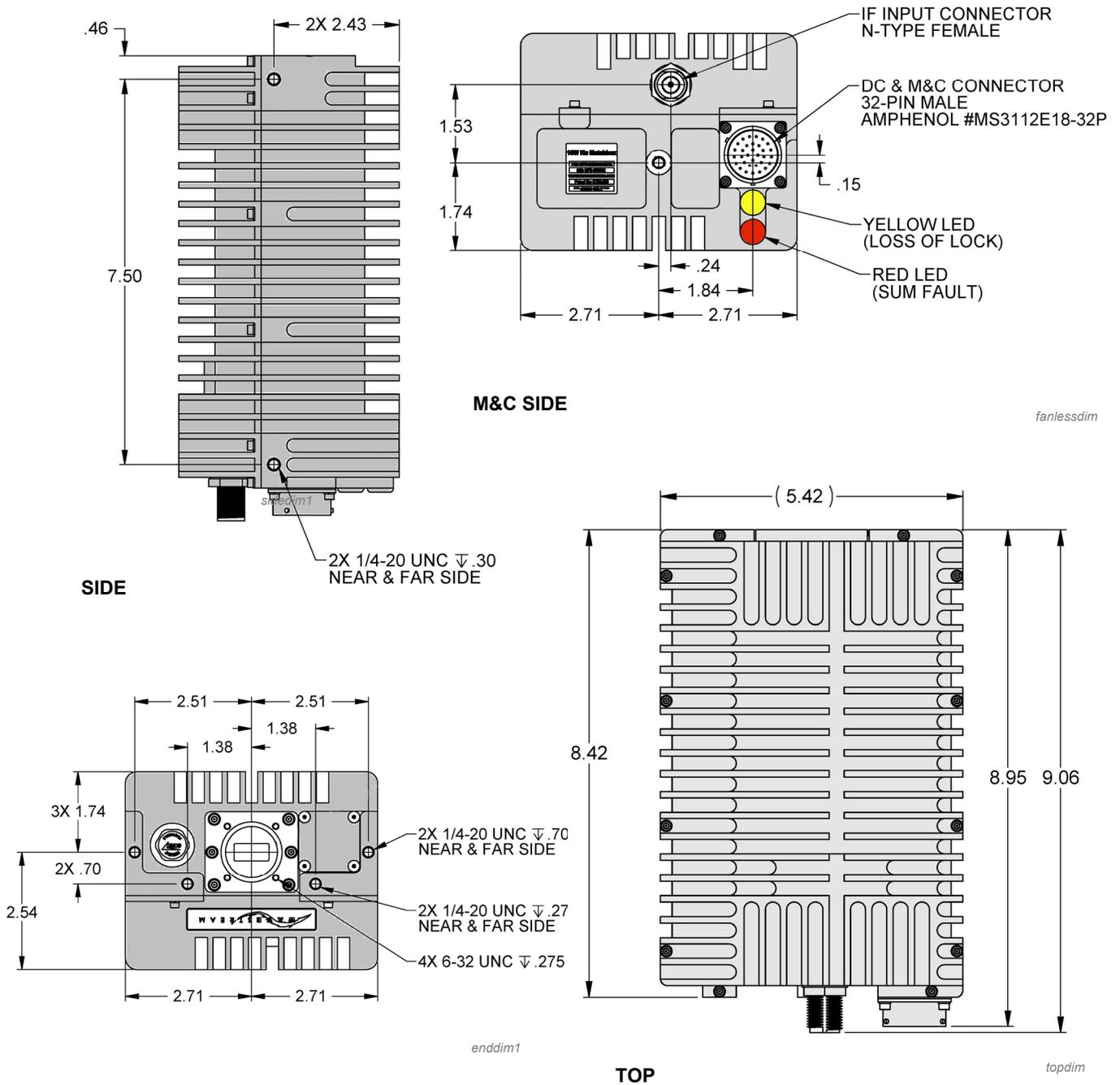
MBB - Fanned Unit Physical Dimensions
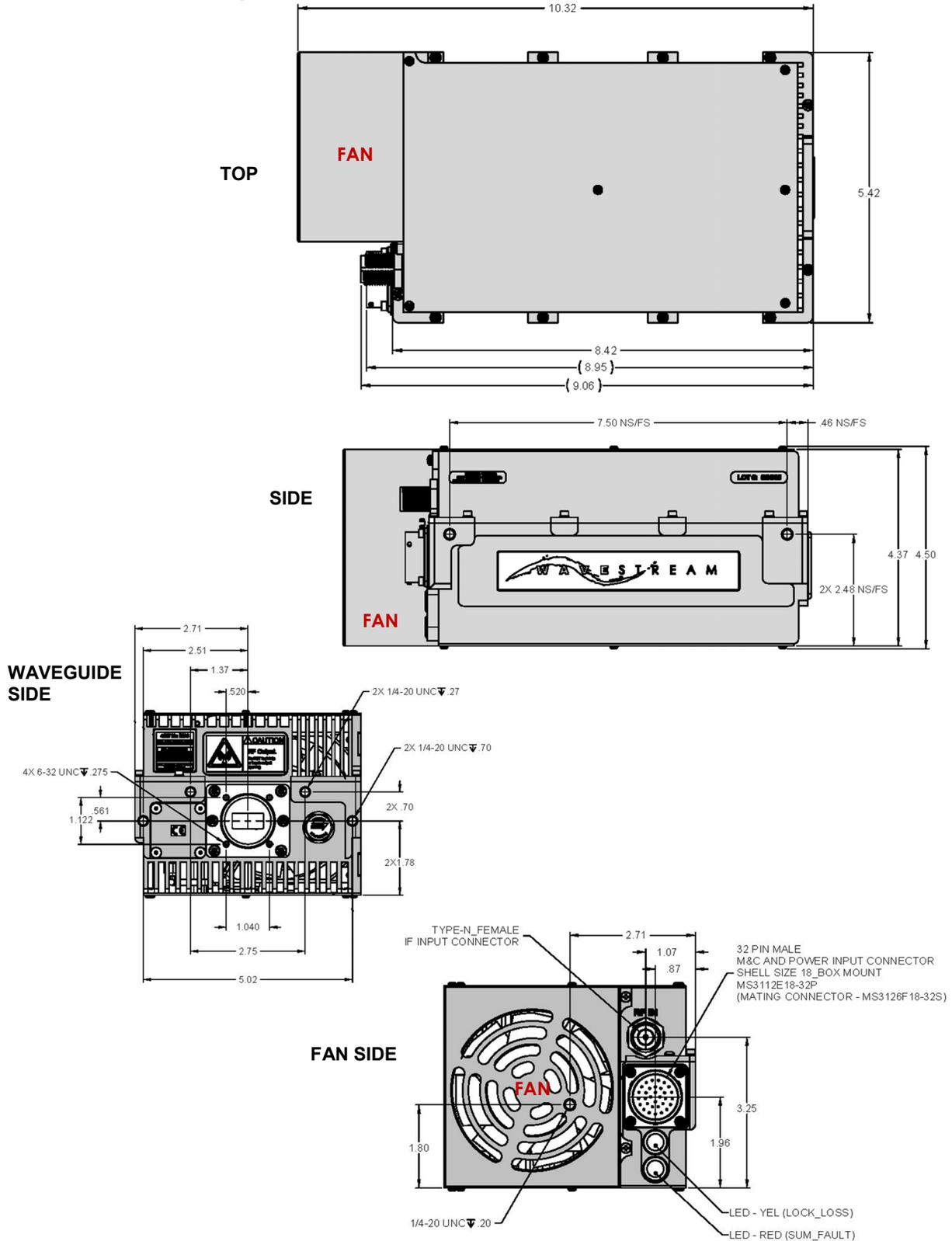
BUC-FANdimensions

System/Equipment Description

Front

Fanned

J1
**IF INPUT CONNECTOR
N-TYPE FEMALE**

J3
**32-PIN MALE
AMPHENOL #MS3112E18-32P
12-PIN MALE
AMPHENOL # PT02E-14-12P**

LOSS OF LOCK (YELLOW LED)

SUMMARY FAULT (RED LED)
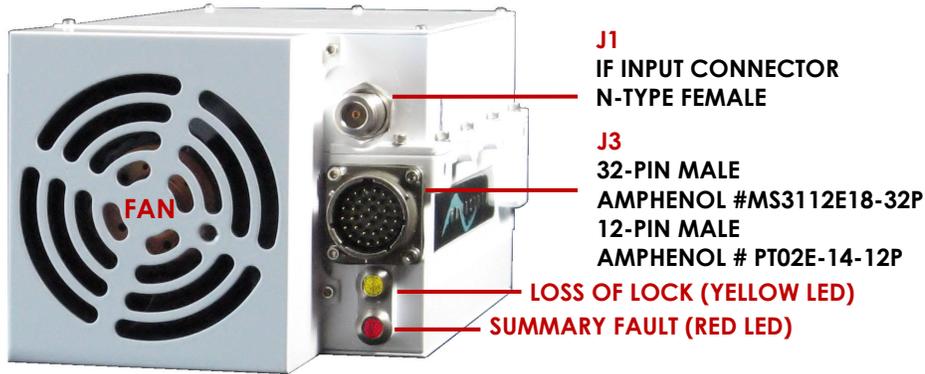
fanbuc

- The fan cools the internal unit components.

- The weatherized fan can handle the elements.

- The fan shuts off when the ambient temperature goes below +23ºC.

Fanless

J1
**IF INPUT CONNECTOR
N-TYPE FEMALE**

J3
32-PIN MALE
or **12-PIN MALE**

LOSS OF LOCK (YELLOW LED)

SUMMARY FAULT (RED LED)
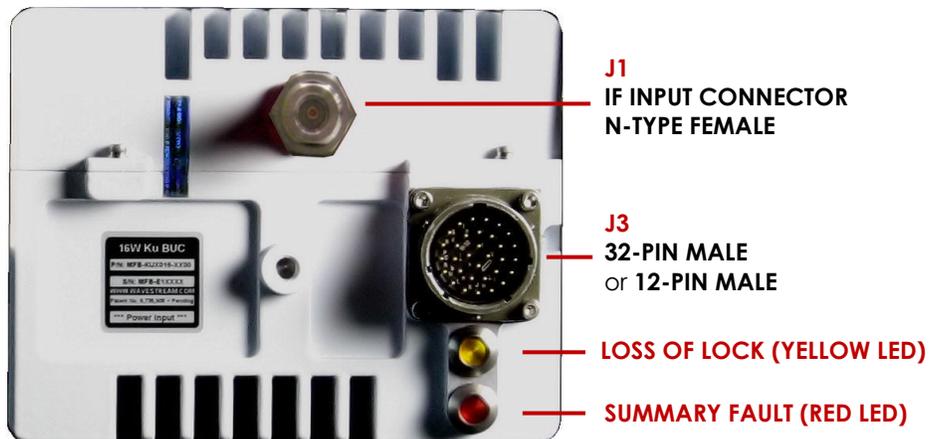
fanlessbuc

LEDs

The LEDs may be disabled using a discrete signal or serial command.

⚠	⚠ C A U T I O N
	Live Output.
	Although the upconverter is muted in the Loss of Lock condition; treat the output as *live* since the amplifier automatically starts transmitting when the upconverter regains lock.

⚠	**C A U T I O N**
	Over-temperature.
	Although the unit stops transmitting in the over-temperature condition; treat the output as *live* since the amplifier automatically starts transmitting once the unit cools.

LED	State	Description
Loss of lock	ON	• The upconverter has lost lock indicating that the 10 MHz reference on the IFL is not present or the signal level is too low. • If lock with 10MHz reference is lost, the upconverter will mute; however the amplifier is still enabled and fully powered
	OFF	Upconverter is locked, 10MHz reference is present.
Summary fault	On steady	Summary fault Over-temperature: • Unit temperature has exceeded its internal cut-off. • Power to the internal amplifier module is cut off automatically if the internal temperature reaches a point where the amplifier might be damaged. Amplifier failure: • A key internal circuit has malfunctioned or the input voltage/current is out of its allowed range**.**
	Blinking	Loss of lock
	Fading:	Summary fault and loss of lock
	OFF	Unit temperature within acceptable range, internal circuits are ok, input voltage/current is within allowed range.

Waveguide Side

FANNED

J2

WR75 OUTPUT

PRESSURE VENT (do not remove)

FANLESS

J2

WR75 OUTPUT

PRESSURE VENT (do not remove)
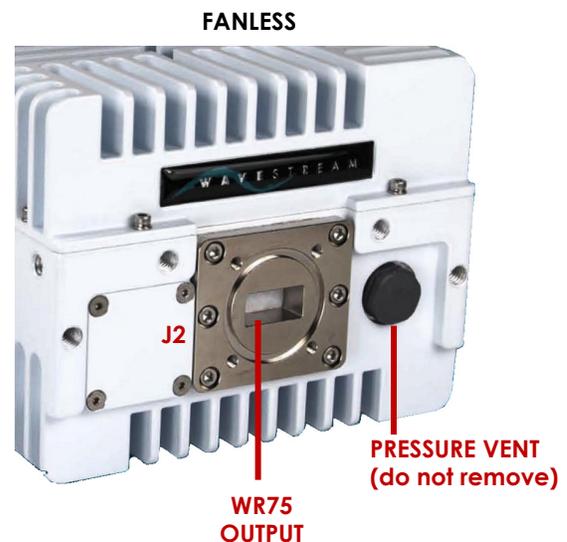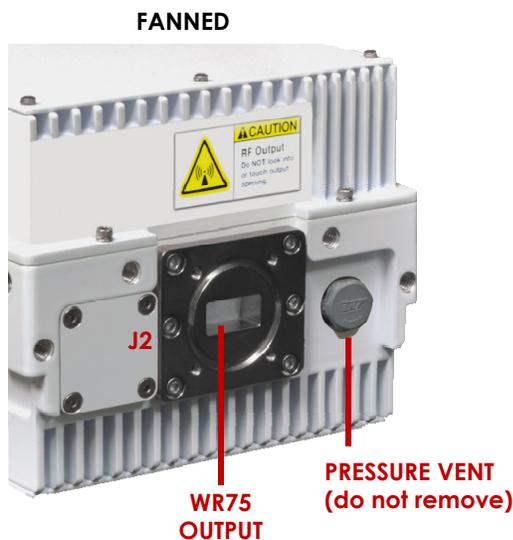
front

Interfaces

Interface cables are customer provided. The Ku-Band Matchbox BUC has the following interface connectors. The following sections provide pin out and signal information for each connector. Use this information to build interface cables.

ID	Name	On Unit	Mating Connector
J1	IF IN	Type N female connector	Type N male connector
J2	RF OUT	WR75 waveguide flange	WR75 waveguide
J3	Monitor and Control	**32-pin** Bayonet-style circular connector - Amphenol P/N: A654-MS3112E18-32P	Select one: Amphenol P/N: MS3126F18-32S ITT Cannon P/N: MS3126F18-32S
		12-pin Bayonet-style circular connector – Amphenol P/N: PT02E-14-12P	Select one: Amphenol P/N: PT06E-14-12S ITT Cannon P/N: MS3116F14-12S (solder) ITT Cannon P/N: MS3126F14-12S (crimp)

Power

To prevent damage ensure that the proper voltage range and polarity are selected BEFORE applying input power. Without the optional AC / DC Converter power supply, the BUC requires DC power. VDC is typically applied via J3 the circular connector or J1 for IFL units, this depends on the model.

The part number shown on the model label identifies the correct power selection, for example:

25W Ku BUC
P/N: M B B – K U S 0 2 5 – D S 0 0
S/N: M B B – XXXXXX
WWW.WAVESTREAM.COM
Patent #: 5,736,908 + 7,4,00,215
48 VDC

M B B – K U S 0 2 5 – D S 0 0

C = 28VDC
D = 48 VDC
J = 48 VDC over IFL
K = 24 VDC over IFL

In this example, the part number (D) shows that the unit requires 48 VDC prime.

See Appendix E for AC power supply information.

J1 - IF IN Connector

- N-type female connector
- The nominal impedance is 50 ohms
- Do not exceed +10 dBm on the IF input
- IF input is multiplexed with a 10 MHz reference signal
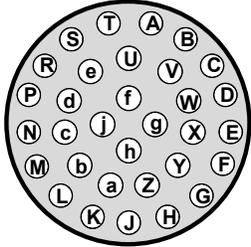- On models with IFL, VDC is multiplexed on this connection

J2 - RF OUT

- RF OUT is a WR75 waveguide flange
- Nominal impedance: 50 ohms

J3 - DC and Monitor and Control Connector

32-pin Bayonet-style Circular Connector

Signal Descriptions

Pin	Signal	Signal Type	Reference	Description	States
A	Prime	Power	Prime_Rtn		
B	Prime	Power	Prime_Rtn		
C	Prime	Power	Prime_Rtn		
D	Prime_Rtn	Power Rtn			
E	TX+ Ethernet	Com	Secondary GND		
F	TX- Ethernet	Com	Secondary GND		
G	RX+ Ethernet	Com	Secondary GND		
H	RX- Ethernet	Com	Secondary GND		
J	RS-485 GND / RS-232 GND	RS-485 GND (use with RS-485)	Digital GND, secondary side		
K	RX- RS-485	Com	Digital GND		
L	RX+ RS-485 / RS-232 RX	Com	Digital GND		
M	TX- RS-485 / RS-232 TX	Com	Digital GND		
N	TX+ RS-485	Com	Digital GND		
P	Prime_Rtn	Power Rtn			
R	Prime	Power	Prime_Rtn		
S	Prime	Power	Prime_Rtn		
T	Prime	Power	Prime_Rtn		
U	Prime_Good Ref	Prime_Good Reference	Filtered Prime_Rtn		
V	Prime_Rtn	Power Rtn			
W	Prime_Rtn	Power Rtn			
X	TX_Active	Monitor-TTL	Secondary GND	Inverted read back of /TX_EN. Indicates whether the /TX_EN signal is being received or not.	**High**=unit receiving /TX_EN signal

Pin	Signal	Signal Type	Reference	Description	States
					(/TX_EN is low) **Low**=unit not receiving /TX_EN signal (/TX_EN is open)
Y	HPA_Off	Monitor-TTL	Secondary GND	High if the internal amplifier does not have power [i.e. the unit is effectively off.] This can be a normal situation if the unit has not been enabled.	**High**=RF Amplifier is Off **Low**=RF Amplifier is ON
Z	Over_Temp	Monitor-TTL	Secondary GND	High if the unit is in an over-temp condition.	**High**=unit is over-temp **Low**=normal unit operation
a	Analog_Temp	Monitor-Analog (0-5V)	Secondary GND	Signal between 0 and +5V indicates relative temperature inside the amplifier. Consult factory for detailed information.	
b	Lock_Loss	Monitor-TTL	Secondary GND	Loss of lock. Signal comes from the upconverter and indicates phase lock to the 10 MHz reference, TTL.	**High**=loss of lock **Low**=locked
c	Sum_Fault	Monitor-TTL	Secondary GND	Unit is over-temperature or there is a serious fault with the amplifier. If the signal Over_temp is low then the fault is with the amplifier – return the unit to the factory.	**High**=fault encountered **Low**=unit operating normally
d	Prime_Rtn	Power Rtn			
e	Prime_Rtn	Power Rtn			
f	Prime_Good	Monitor-Analog / TTL (0-5.6V)	Prime_Good_Ref	High (3.7V to 5.1V) if Prime Power (24V or 48V) is good. Reference is Ref Prime_RTN (pin U).	**High**=prime power is good **Low**=prime power voltage is too low
g	/TX_EN	Control	Secondary GND	Enables the unit. If the signal is grounded to Secondary GND (pin h), the unit will be hard-wired enabled. If the signal is left open, the unit is not hard-wired enabled. Hard-wired enable setting overrides the serial M&C disable setting.	**Open**=disable unit **Low**=enable unit
h	GND	Secondary GND, Return		Secondary ground, reference for all discrete signals except Prime_Good	
j	/LED_Off	Control	Secondary GND	Disables the LEDs. If the signal is grounded to the Secondary GND (pin h), the LEDs will not light (includes during startup, fault, or loss of lock)	**Open**=LEDs operation normal **Low**=LEDs will not turn on

12-pin Bayonet-style Circular Connector

N o t e

If the cable will be 6 feet or longer, Wavestream recommends use of multi-conductor shielded cable to reduce noise pickup.

Connect the shield to the case.

Signal Descriptions

Pin	Signal	Signal Type	Reference	Description	States
A	GND_LOGIC				
B	RS-485 GND	RS-485 GND (use with RS-485)			
C	RX- RS-485	Com	Digital GND		
D	RX+ RS-485	Com	Digital GND		
E	TX- RS-485	Com	Digital GND		
F	TX+ RS-485	Com	Digital GND		
G	SUM_FAULT	Monitor-TTL	Secondary GND	Unit is over-temperature or there is a serious fault with the amplifier. If the signal Over_temp is low then the fault is with the amplifier – return the unit to the factory.	**High**=fault encountered **Low**=unit operating normally
H	/TX_EN	Control	Secondary GND	Enables the unit. If the signal is grounded to Secondary GND (pin h), the unit will be hard-wired enabled. If the signal is left open, the unit is not hard-wired enabled. Hard-wired enable setting overrides the serial M&C disable setting.	**Open**=disable unit **Low**=enable unit
J	PRIME	Power	Prime_Rtn		
K	PRIME_RTN	Power Rtn			
L	PRIME	Power	Prime_Rtn		
M	PRIME_RTN	Power Rtn			

⚠ W A R N I N G

Wiring.

Incorrect cable wiring can permanently damage this unit.

The serial transmit / receive signals are not crossed inside the unit.

To communicate with the unit over a serial connection, cross the signals externally.

RS-485 Serial Interface (part numbers ending in xSxx)

The serial transmit/ receive signals are NOT crossed internally. You must externally cross the RX and TX signals for serial communications on the M&C interface.

For the 32-pin connector:

Pin	Signal Name	Customer side connection
J	RS-485 Gnd	Ground
K	RX-	TX-
L	RX+	TX+
M	TX-	RX-
N	TX+	RX+

RS-232 Serial Interface (part numbers ending in xRxx)

The serial transmit/ receive signals are NOT crossed internally. You must externally cross the RX and TX signals for serial communications on the M&C interface.

For the 32-pin connector:

Pin	Signal Name	Customer side connection
J	RS-232 Gnd	Ground
L	RX	TX
M	TX	RX

Ethernet Interface (part numbers ending in xExx)

For the 32-pin connector:

Pin	Signal Name	Customer side connection
E	TX+ Ethernet	TX+ Ethernet
F	TX- Ethernet	TX- Ethernet
G	RX+ Ethernet	RX+ Ethernet
H	RX- Ethernet	RX- Ethernet
h	GND	GND

Installation and Configuration

The Ku-Band Matchbox BUC may be mounted directly to the antenna feed supported by the WR75 output flange. Alternatively it may be mounted with support by its sides, front and back.

OPTIONAL AC POWER SUPPLY

BUC

AC OUTLET

Wavestream #: 02-012-0009
USB to RS-485 adapter
B&B Electronics
(485USB9F-4W)

CONTROLLER

Equivalent Connectors

1	4-pin mating connector Wavestream #: 06-005-0238 Amphenol CD16 20D003 110 12
2	19-pin mating connector Wavestream #: 06-005-0236 ITT Cannon MS 3126F14-19S
3	32-pin mating connector, male Wavestream #: 06-005-0388 Pei Genesis KPT06UT18-32P
4	D-sub 9-pin mating connector, male Wavestream #: 06-005-0035 ITT Cannon DEMAM9P
5	32-pin mating connector, female Wavestream #: 06-005-0261 Amphenol MS3126F18-32S

OPTIONAL Cables
(available from Wavestream)

7	AC Power Cable Wavestream #: 02-009-0094 10 feet – included
8	M & C Cable Wavestream #: 02-009-0092 8 feet M & C Cable Wavestream #: 02-009-0091 4 feet
9	M & C Cable Wavestream #: 02-009-0093 10 feet
10	USB-A to USB-B Cable Wavestream #: 02-009-0163 3 feet

setup1

Ethernet

OPTIONAL AC POWER SUPPLY

J3   J2   J1

① ② ③

BUC[16W, 25W. 40W]

⑥ ⑧

⑦

AC OUTLET

⑫ *RJ-45*

⑪ *To network connection*

④

Not required if Ethernet control is used

02-012-0009
USB to RS-485 adapter
B&B Electronics
(485USB9F-4W)

⑩

Network connection

CONTROLLER

Equivalent Connectors	
①	4-pin mating connector 06-005-0238 – included with unit Amphenol CD16 20D003 110 12
②	19-pin mating connector 06-005-0236 ITT Cannon MS 3126F14-19S
③	32-pin mating connector, male 06-005-0388 Pei Genesis KPT06UT18-32P
④	D-sub 9-pin mating connector, male 06-005-0035 ITT Cannon DEMAM9P
⑤	12-pin mating connector, female 06-005-0390 Pei Genesis KPT06UT14-12S
⑥	32-pin mating connector, female 06-005-0261 Amphenol MS3126F18-32S

OPTIONAL Cables (available from Wavestream)	
⑦	AC Power Cable Wavestream #: 02-009-0094 10 feet – included
⑧	M & C Cable Wavestream #: 02-009-0092 8 feet M & C Cable Wavestream #: 02-009-0091 4 feet
⑤	M & C Cable Wavestream #: 02-009-0144 4 feet
⑩	USB-A to USB-B Cable Wavestream #: 02-009-0163 3 feet
⑪	M & C Cable Wavestream #: 02-009-0093 10 feet
⑫	M & C Cable with Ethernet breakout Wavestream #: 02-009-0189 10 feet

setup2

Required Tools / Supplies

- Screwdriver

- Torque wrench

- Cable manufacturing tools

Installation Precautions / Prerequisites

	⚠️ **C A U T I O N**
🚫💧	**Moisture sensitive.** Tightly connect and seal the RF input, power, and M&C connections against moisture using good commercial practice and UV-rated materials.

	⚠️ **C A U T I O N**
⚠️	**Contamination sensitive.** Exercise care when installing the O-ring for the WR75 waveguide connection. Prevent contaminants from entering the interface and avoid pinching the gasket.

Inspection and Unpacking

- Keep the shipping box and all packing materials for future use, including return of the unit for repair.

- Inspect the unit for any visible damage. If the unit is damaged, follow the warranty RMA.

- Inspect the waveguide and remove any foreign objects such as packing material.

- Inspect the membrane inside the waveguide opening; verify that it is not damaged.

- Verify that the connector pins on the rear are intact and ready for connection.

Fan

MBB units include a fan in the unit.

- The fan is weatherized to handle the elements.

- The fan is field replaceable with a Wavestream Fan Replacement kit (P/N: 02-012-0024).

- When the ambient temperature goes below +23°C the fan automatically shuts off. When the temperature rises above +23°C the fan automatically turns on.

Mounting

Mount the unit in accordance with standard practice.

ℹ	**N o t e** *Use the correct length mounting hardware screws.* *If the screw length is excessive it will damage the equipment.*

≋	⚠ **C A U T I O N** **Fan unit airflow.** The slots and openings provide forced air convection ventilation and air flow. Do not block these openings. Verify that the unit is mounted at least 3 inches from any obstruction.

≋	⚠ **C A U T I O N** **Fanless unit airflow.** The fins provide natural air convection ventilation and air flow to surrounding air. Do not obscure the fins. Allow a minimum of 12 inches of air around the unit. The unit is NOT intended for radome environments.

When mounting the unit in a closed area, such as a building or radome, ensure that proper ventilation is provided. The internal operating temperature should not exceed the maximum rated temperature.

((•))	⚠ **W A R N I N G** **High Power RF Hazard.** Do not energize the unit until it is completely installed. High power RF energy emissions could be harmful.

Cross-pole Installation

Use the ¼-20 hole located on the center of the back of the unit to mount a support for cross-pole operation.

FANNED

FANLESS

Install the Waveguide

Verify that the membrane is visible inside the WR75 waveguide. If not, contact Wavestream support.

⚠ C A U T I O N
Protective surface.
Do not puncture or damage the membrane inside the WR75 waveguide flange.

1. Ensure that the waveguide gasket (O-ring) is clean.

2. Place the waveguide gasket (O-ring, McMaster-Carr P/N: 9396K68) into the groove in the waveguide flange prior to mating this interface to ensure a water-tight connection.

3. Do not pinch the O-ring when installing the unit onto the feed.

4. Attach the RF output / waveguide.

5. Use 6-32 UNF screws of the appropriate length and torque the retaining screws to 10-11 inch-pounds.
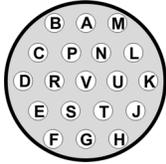
Cabling

1. Visually verify that the connector pins are not damaged.

2. Perform a continuity check on all cables prior to installation.

⚠ W A R N I N G
Wiring.
Incorrect cable wiring can permanently damage this unit.

19-pin Connector

This is applicable even if you are using the optional external AC/DC power supply.

N o t e

If the M & C cable will be 6 feet or longer, Wavestream recommends use of multi-conductor shielded cable to reduce noise pickup.

Connect the shield to the case.

Pin	Signal	Signal Type	Reference	Discrete M&C Signal Description	States
A	GND	Secondary GND (SGND)		Secondary ground, reference for all discrete signals except Prime_Good	
B	/TX_EN	Control	Pin A Secondary GND	This signal enables the unit. If the signal is grounded to Secondary GND (Pin A), the unit will be hard- wired enabled. If the signal is left open, the unit is not hard-wired enabled. Software TX Enable is logically OR'd with external /TX_EN; either one will enable the unit.	**Open=** Software controls TX Enable **Low =** Unit is always enabled, regardless of the software setting.
C*	RX- Ethernet	Com	Pin A Secondary GND		
D	Not used				
E	Not used				
F	RX- RS-485	Com	Pin G RS-485 GND		
G	RS-485 GND	RS-485 Digital GND Secondary Side	Ground to be used with RS-485		
H	TX- RS-485	Com	Pin G RS-485 GND		
J	Not used				
K	Sum_Fault	Monitor - TTL	Pin A Secondary GND	Indicates that the unit is over temperature or there is a serious fault with the amplifier.	**High**=fault encountered **Low**= normal operation
L*	TX- Ethernet	Com	Pin A Secondary GND		

Pin	Signal	Signal Type	Reference	Discrete M&C Signal Description	States
M	Not used				
N*	TX+ Ethernet	Com	Pin A Secondary GND		
P*	RX+ Ethernet	Com	Pin A Secondary GND		
R	Not used				
S	RX+ RS-485	Com	Pin G RS-485 GND		
T	TX+ RS-485	Com	Pin G RS-485 GND		
U	Not used	Not used			
V	Not used	Not used			

*Applicable if the unit has the Ethernet option

RS-485 Adapter to USB

1. For the RS-485 to USB adapter, follow the directions for installation and operation of the adapter.

2. Connect serial cables between the computer, adapter and the unit.

3. The unit does not cross the TX and RX signals; therefore it is critical to ensure that the 19-pin to 9-pin cable crosses the signals:

   The unit GND is connected to the computer (controller) serial ground pins.

   The serial port adapter must be 4-wire.

SIGNAL NAME	PIN		MATING CONNECTOR
RS-485 GND	J	———	GND
RS-485 RX-	K		RS-485 TX+
RS-485 RX+	L		RS-485 TX-
RS-485 TX-	M		RS-485 RX+
RS-485 TX+	N		RS-485 RX-

M&C connection

1 9-pin mating connector
ITT Cannon MS 3126F14-19S

19-pin to 9-pin cable

D-sub 9-pin mating connector, male
ITT Cannon DEMAM9P

USB to RS-485 adapter
B&B Electronics
(485USB9F-4W)

USB-A to USB-B

CONTROLLER

RS485
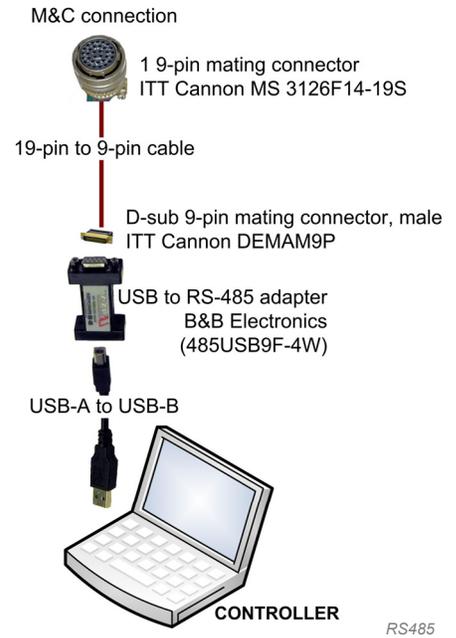
Ethernet Option

This option requires an M&C cable with an Ethernet breakout. Wavestream has an optional cable that may be purchased (Wavestream P/N 02-009-0189).

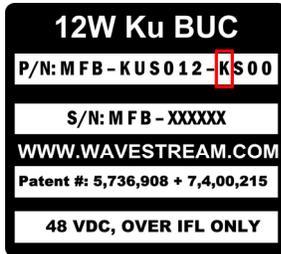When using the Ethernet option, only the breakout cable must be connected.

SIGNAL NAME		PIN		MATING CONNECTOR
TX+	Ethernet	E	———	TX+ Ethernet
TX-	Ethernet	F	———	TX- Ethernet
RX+	Ethernet	G	———	RX+ Ethernet
RX-	Ethernet	H	———	RX- Ethernet
GND		J	———	GND

Connect to AC /
DC Converter
Power Supply

19-pin mating connector
ITT Cannon MS 3126F14-19S

19-pin to
9-pin cable

D-sub 9-pin mating connector, male
ITT Cannon DEMAM9P

USB to RS-485 adapter
B&B Electronics
(485USB9F-4W)

USB-A to USB-B

CONTROLLER

enet2

Power and Grounding

![RF antenna icon]	⚠️ **W A R N I N G**
	RF Energy.
	Do not energize the unit until it is completely installed on the feed and antenna. It emits high power RF energy which could be harmful to the human body.

Interfacility Link (IFL) Configuration

12W Ku BUC

P/N: M F B – K U S 0 1 2 – [K] S 0 0

S/N: M F B – XXXXXX

WWW.WAVESTREAM.COM

Patent #: 5,736,908 + 7,4,00,215

48 VDC, OVER IFL ONLY

The model label includes the power requirements for the unit. If the part number contains a J, K, or L in the power requirements position, then the unit is configured to accept VDC over IFL. In the following example, the 12 W unit will accept 24 VDC over IFL:

M F B - K U S 0 1 2 - [K] S 0 0

J= 48 VDC on IFL / **K** = 24 VDC on IFLp

J1 IFL powered units
Attach the input cable with DC bias voltage on J1, the input RF connector.

J3 Ensure that DC bias voltage is not present on J3, the M&C connector.

fan

Units Configured for Power Over IFL

- Apply power ONLY to J1, the type N connector.
- If DC is applied to J3, the M & C connector, it will not power the unit.

Units Not Configured for Power Over IFL

- Do NOT put DC on J1, the type N connector.
- If your modem has a DC source – disable it.

![warning triangle icon]	⚠️ **W A R N I N G**
	DC Power.
	Application of DC on the IFL if there is no internal bias-T may damage the unit.

DC Power

Without the optional AC / DC Converter power supply, the BUC requires DC power. VDC is typically applied via J3 the circular connector or J1 for IFL units, this depends on the model.

See Appendix E for AC power supply information.

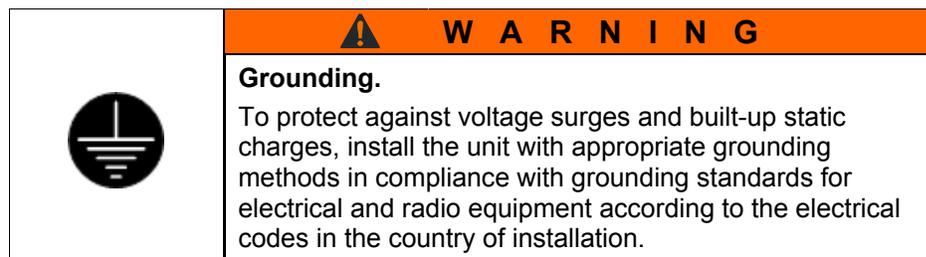1. Look at the model label. The letter at the end of the number sequence as shown below identifies the type of power required.

25W Ku BUC
P/N: M B B – K U S 0 2 5 – D S 0 0
S/N: M B B – XXXXXX
WWW.WAVESTREAM.COM
Patent #: 5,736,908 + 7,4,00,215
48 VDC

M B B – K U S 0 2 5 – D S 0 0

C = 28VDC
D = 48 VDC
J = 48 VDC over IFL
K = 24 VDC over IFL
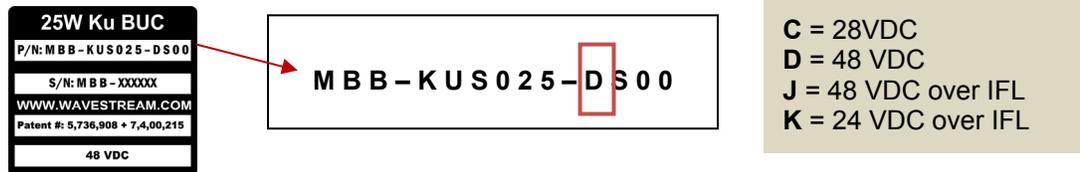
2. Select the correct power for the model. In this example, the unit requires 48 VDC prime.

3. The default power on mode is that once power is applied; the unit will automatically energize with transmit enabled.

Grounding

Ensure that the unit is protected against voltage surges and built-up static charges.

⚠ **W A R N I N G**
Grounding. To protect against voltage surges and built-up static charges, install the unit with appropriate grounding methods in compliance with grounding standards for electrical and radio equipment according to the electrical codes in the country of installation.

Configuration

Pin g on J3 (**/TX_EN**). The M&C cable can be used with a safety interlock system to enable/disable the unit. Refer to the Monitor and Control Interface description.

Tie pin **g** (**/TX_EN**) to pin **h** (secondary ground) to enable the unit.

Serial or Ethernet Monitor and Control

1. For serial or Ethernet (option) M&C applications, the discrete /TX_EN signal does not have to be connected.

2. If the unit uses serial or Ethernet monitor and control, the discrete /TX_EN signal does not have to be connected. The unit may be enabled using either the serial or Ethernet connection.

3. If /TX_EN is grounded, this condition overrides (forces ENABLE) the state of the serial or Ethernet configuration.

    Monitor and control signals are simply passed through the AC power supply to/from the BUC.

Hard-wired Enable

To enable RF operation as soon as power is applied without having to send a command, hard-wire **/TX_EN** to ground.

- On J3 connect pin **h** (**Secondary GND**) to pin **g** (**/TX_EN**).

- If you are using the optional AC power supply, see Appendix E – AC Power Supply.

Serial units

- Save the **/TX_EN** setting. See Appendix A – SAbus Protocol for more information.

- Once **/TX_EN** is hard-wired to be enabled, the unit cannot be disabled using commands.

- Power down the unit to disable it.

Discrete Enable

To enable RF operation using a discrete enable signal without sending a command, wire the unit to an open collector on the user side.

- On J3 connect pin **h** (**Secondary GND**) and pin **g** (**/TX_EN**) to the user open collector circuit.

- If you are using the optional AC Power Supply, see Appendix E – AC Power Supply.

> **N o t e**
> *Up to 100 ohms of resistance is tolerated on the /TX_EN line.*

- Once **/TX_EN** is enabled using the discrete signal, the unit cannot be disabled using commands.

- To disable **/TX_EN** switch the open collector circuit so that **/TX_EN** is not grounded or power down the unit.

RS-485 Serial Command Enable

RS-485 serial commands may be used to enable and disable the unit. For details, see Appendix A – SAbus Protocol.

Serial control of the **ENABLE** signal is possible. If the **ENABLE** signal is hard-wired or discrete-controlled, then this ENABLE condition will override the software command.

GUI

The GUI provides a communication and monitoring interface for the Ku-Band Matchbox BUC. The GUI firmware is installed on a control computer.

System and Software Requirements

Connection to the controller may be via serial port, USB (using an RS-485 adapter) or Ethernet for units with the Ethernet option.

Control Computer Specifications

Operating system	Windows
Port	RS-232 / RS-485

Required Equipment / Tools

Wavestream Matchbox Software CD	Setup.exe wavestreamgui.exe
Lantronix	DeviceInstaller.exe (www.lantronix.com)
Serial port adapter	RS-232 to RS-485 (on COM1) or USB to RS-485 adapter not required for units using the Ethernet option
Ethernet	RJ-45 breakout cable for units with the Ethernet option

Serial Port Installation

Baud rate	9600 bits per second
Bits per character	8
Parity	none
Stop bits	1

1. From the controller computer **Start** menu select **Control Panel** → **System** → **Hardware & Sound** → **Device Manager** → **Ports**.

2. Double-click the serial com port that you will use (generally this is COM1).

   a. Ensure that no other programs are using the serial port that will communicate with the unit.

   b. Select the **General** tab; verify that the device is enabled.

   c. Select the **Port Settings** tab. Verify that the port is set up correctly.

3. If you need to assign a specific IP address, refer to Appendix C for instructions.

GUI Installation

1. Copy all files from the CD to a directory on the controller.

2. Double-click **Setup.exe**.
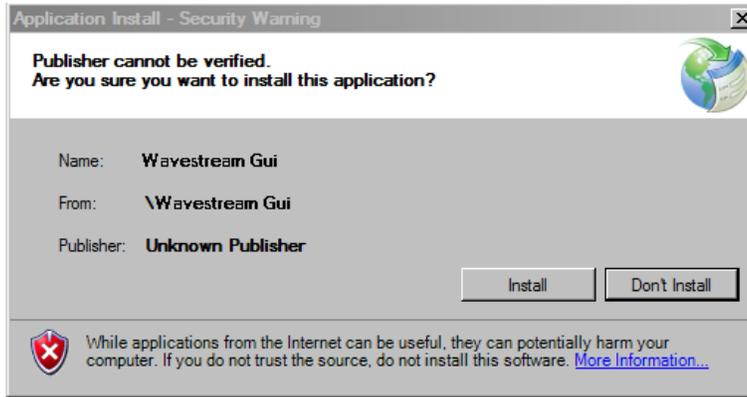
install-controller

3. Click **Install**.

4. The program uses Microsoft .net Framework. This software will automatically be installed if setup does not detect it.

## GUI Configuration

1. Double-click **WavestreamGUI.exe**.

splash

2. The unit will automatically be recognized.

3. Click **Search Serial Ports**. A list of available ports will be displayed in the next window.
Click the dropdown arrow to list all available ports.
Select the appropriate one.

4. Click **Start**.

   If this port is not available an error message will be displayed. Click **OK** and select a different port.
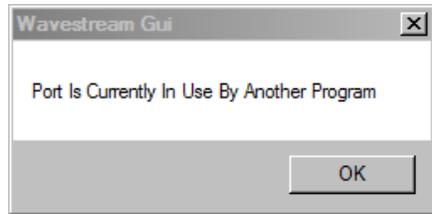
portNuse

5. Click **Start** to start communication between the unit and the PC.

GUIremote

6. Confirm connectivity by movement on the progress bar [green dots] which indicates that there is activity between the unit and GUI.

Step Attenuation	Allows the user to attenuate the amplifier by 2 dB increments. The value will be changed immediately on the unit. The unit provides a range from 0 to 20 dB minimum of attenuation.
	*NOTE***:** Click **Save Settings → Save Attenuator Setting** to save the state in non-volatile memory so that the unit will power up in this state. The unit will revert to the saved value at power up.
Start	Allows the user to start communications to the specified port. Once connected data will be displayed.
Search Serial Ports	Provides a list of ports for communication between the unit and the controller via a dropdown box. Click **Start** to start communications to that port.
[log field]	Displays every time- stamped command or status activity including any faults that may have occurred in the unit. This scrollable log is located below the main screen.

Unit Information

Serial Number	Provides the unit serial number.
Model Number	Provides the model number of the unit.
Firmware Version	Provides the version of firmware that is running on the unit.

Temperature

Temperature	Displays the temperature of the unit's internal M&C board in degrees C.
Fan Speed	Displays the fan speed. Fan speed depends on the system temperature and automatically increases or decreases to control the overall temperature.

Power Supply

Drain Voltage	Displays the analog output voltage from the internal power supply.
Drain Current	Displays the analog output current from the internal power supply.

Unit LED

LED	Indicates if the LEDs on the unit have been enabled or disabled via **Save Led Settings (Save Settings → Save Led Settings)**.

Unit Status

Summary Fault	[*OK/Fault]* Displays the status of the Summary Fault signal. If the signal reads *Fault*, one of the following has occurred: • the unit is over temperature • the unit cannot safely turn on due to bias problems • the amplifier is off when it has not received an enable signal
Over Temp	[*OK/Fault*] Displays the status of the Over Temp signal. If the signal reads *Fault*, the unit is over the operating temperature and has shut down. The unit will automatically clear this fault and be enabled when the temperature goes below the shutoff threshold.
Gate	[*OK/Fault*] Displays the status of the internal bias for the amplifier. If the signal reads *Fault*, then there is a bias problem internally and the unit must be returned via RMA to Wavestream for repair.
HPA	[*On/Off*] Displays the status of the unit's amplifier.

RF

RF Fwd Power	Displays the analog RF forward power level in dBm. Note that for RF forward power readings below 25 dBm, the forward power may not read accurately.
Step Attenuation	Displays the saved gain attenuation.
10 MHz Reference	[*OK/Fault*] Displays the status of the BUC 10 MHz reference signal. If the display shows *Fault*, the unit has lost lock on the 10 MHz reference signal.

Tx Status: [Active]

|	
Ext Tx Enable	[*Enabled/Disabled*] Displays the status of the external Tx enable signal. If Software Tx Enable is enabled and Tx Enable is disabled, then the unit is enabled.
Software Tx Enable	[*Enabled/Disabled*] Displays the status of the software Tx enable signal. Software Tx Enable is logically OR'd with the External Tx Enable; either one will enable the unit.

Unit Serial Connection

Green dots in lower left	Indicates the existence of serial connection activity. • If the series of dots is moving, then the GUI is connected to the unit. • If there are no dots or the dots have stopped moving, the GUI is not communicating with the unit. • The number to the right of the box indicates cumulative packets transferred.
Unit Address	Displays the unit address.

Toolbar Menus

Save Settings
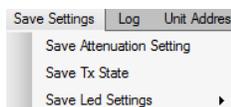
Allows the user to save a setup value for the unit.

Save Attenuation Setting **–** saves the state in permanent memory so that the unit will power up in this state.

Save Tx State **–** [*Enabled/Disabled*] saves the transmitter state.

Save Led Settings **–** allows the user to choose whether the LEDs are enabled or disabled.
Note, the LED's will turn on for a brief moment at start up even if this software LED command is used. If you do not want the LED's to turn on even during start up, then use the hardwired LED disable signal.

Log
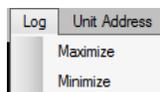
Opens a scrollable log field below the main screen. Each entry is a time-stamped command or status activity including any faults that may have occurred.

Unit Address
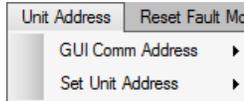
GUI Comm Address – displays the address of the unit that the GUI selects for communication. The user can change the address by clicking on it and selecting the different address.
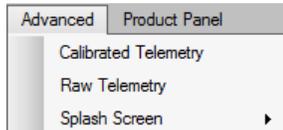
Set Unit Address – allows the user to change the default address (0x30) to an address different from the default [e.g. if in a chain]. To change the unit address, first connect to the unit via the existing address.

Reset Fault Mode

Allows the user to reset a forward power or reflected power fault.

Advanced

Calibrated Telemetry – displays calibrated telemetry values.

Raw Telemetry – displays raw telemetry values (internal measurement).

Splash Screen – allows the user to enable or disable showing the splash screen when starting the GUI application.

Operation

Power On

start

1. Verify that all cables and the waveguide are connected.

2. Apply power.

3. The Home page will be displayed on the GUI.

Configuration

There are two ways to configure transmit enable for the unit.

*   <u>Hardwire</u>
    /TX_ENABLE, pin B is tied to Secondary Ground (pin A).
    The unit is enabled at power up and can only be disabled by allowing /TX_ENABLE to float (software commands will be ineffective).

*   <u>Software GUI Enable / Disable</u>
    Provides total control via software commands. The Wavestream GUI can enable or disable transmit by selecting the software buttons TxEnable or Tx Disable on the GUI. Hard-wired /TX_ENABLE (pin B) must be left open.

Select Power On Setting

To configure the power on setting:

*   Apply the external TX enable

*   Or configure the power on setting in the GUI and save the default TX setting so that it will be enabled at power up

Set or Change the Step Attenuation
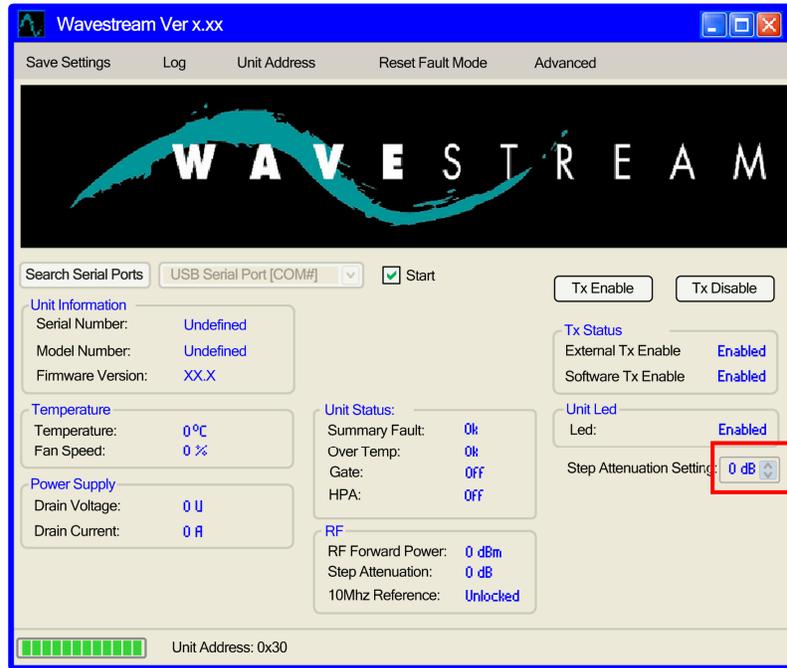
start

- Press the up and down arrows to set the gain attenuator to a specific value. The unit holds 0 to 20 dB minimum of attenuation

- Click **Save Settings → Save Attenuator Setting**

System Faults and Activity

To view the system faults that have occurred click **Log** on the toolbar.

A scrollable field will appear below the GUI. It displays a time-stamped list of command and status activity for the unit as well as any faults that may have occurred.

Maintenance / Service

The unit is low maintenance and service-free.

Frequency	Inspection to perform	Description
6 months	Equipment and connections	Inspect equipment and connections
6 months	Fan intakes and exhausts	Ensure they are free of debris
6 months	Waveguide mounting screws	Verify torque is 10-11 inch-pounds
6 months	Connectors	Remove corrosion Verify they are securely connected

Fan Assembly Replacement

The fan assembly is field replaceable. Contact Wavestream for a replacement kit.

Service

Do not attempt to service this equipment; there are no internal replaceable components or assemblies. Under all circumstances contact Wavestream or your distributor for service.

⚠ **D A N G E R**
Hazardous Voltage.
Opening or removing the cover of the unit may expose you to dangerous voltages, high power RF energy or other hazards as well as void your warranty.

N o t e

Opening or removing any component or sealed area will immediately void the warranty.

Troubleshooting

Satellite networks can be difficult to troubleshoot because the user/installer is typically not at the same location as the other end of the link.

This section describes problems that may be unique to the unit and provides recommended solutions. Before performing any of the troubleshooting procedures in this chapter, it is important to read the Safety Information. Follow all safety procedures when performing any troubleshooting operations.

Troubleshooting

If there is no communication between the GUI and unit in serial applications, check the following:

- If the unit is connected to a serial line, verify that there is a cross in the cable.

- Verify that the unit has power.

- Verify that there is no other device using the serial line.

- Sometimes, programs may not properly close their serial connection and this may prevent the GUI from communicating with the unit. Reboot the controller (computer).

- Use the GUI to perform a search for an available Com port.

- Press **Search Serial Ports** on the GUI. The GUI software will search the available Com ports until it can communicate with the unit. Once it establishes communications with the unit, it will display the valid Com port.
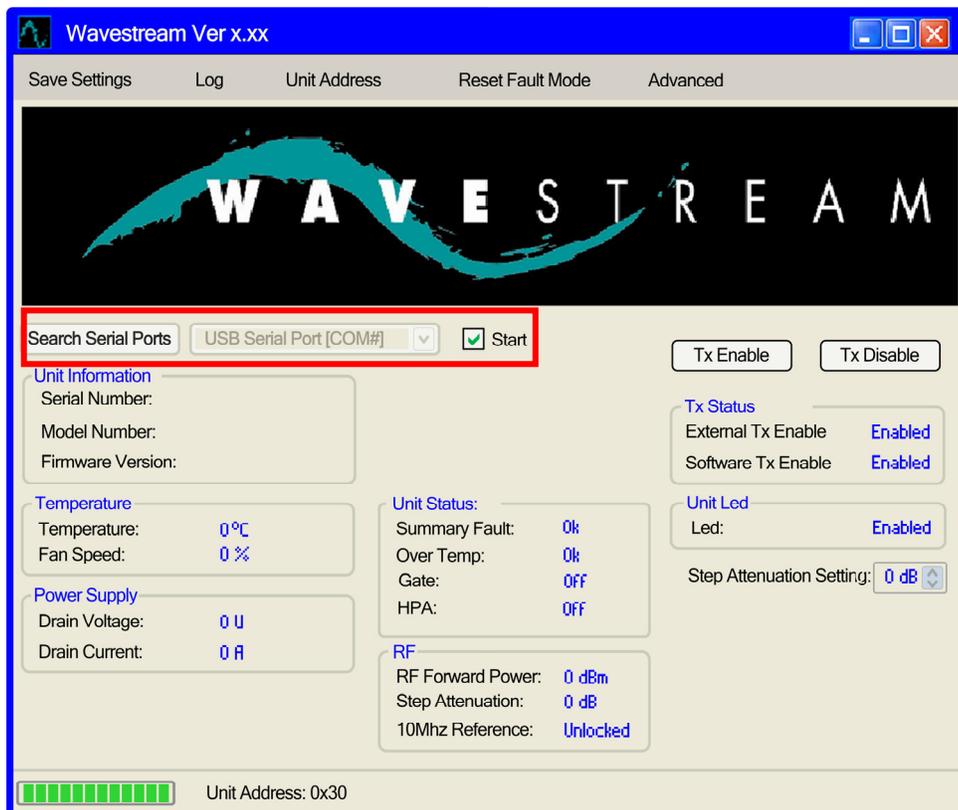
- When **Start** is pressed, the GUI queries the BUC and displays the current status.

Diagnostics

No LEDs are lit; the fan is operating
• The LEDs are not lit during normal operating condition of the unit. • The fan should be operating unless the ambient temperature is below +23°C. • The LEDs can be disabled either by bringing the /LEDS_OFF signal low or by issuing a serial command.
Verify that the unit is enabled. • Check the /TX_EN signal state. • If the serial option is being used, check for TX_EN and HPA_Off signals.
Verify the RF input and output. • Verify that the RF input to the unit is functioning. • Remove DC power from the unit first, then check the output waveguide and feed for obstructions or other foreign materials. Review the Safety Precautions. ⚠️ **C A U T I O N** **Live Output.** Although the unit stops transmitting in the over-temperature condition; treat the output as "live" since the amplifier automatically starts transmitting once cooled.

No LEDs are lit; the fan is not operating
This symptom typically indicates that DC power is not being applied properly. • When the ambient temperature is below +23°C, the fan turns off. • If the transmit duty cycle is low (less than 25%) and/or the output power level is low (set by the gain attenuator or by a low IF signal), the fan may shut off at higher ambient temperatures. • Disable the LEDs by bringing the /LEDS_OFF signal low or issuing a serial command. • If the LEDs and the fan are off and lack of power is suspect; perform the following:
Verify that the DC connector has power. • Turn off power to the system. • Disconnect the DC power cable from the unit. • Turn on the power source and use a voltmeter to verify that the right voltage and polarity are available at the correct pins. • Apply VDC on the military circular connector or on the IFL depending on the model number. The part number on the unit identifies the proper voltage, for example: M B B – K U S 0 2 5 – D S 0 0 **Where, D = 48VDC, C = 24VDC, J = 48VDC on the IFL, or L = 28VDC on the IFL** *This example part number identifies the unit as requiring a 48 VDC Prime.*
Verify that the M & C connector is fully seated. • The bayonet-style connector will click when it is completely seated.

LOL is lit
• This condition indicates the unit has lost lock with the 10 MHz reference on the IFL.   • If this condition occurs, perform the following:
Verify 10 MHz presence on modem.   • If the 10 MHz signal can be turned on/off, verify that the reference is ON.
Check connections.   • If the IFL run is long, verify that the connections are seated properly. A low reference signal level can cause loss of lock.

| SUM FLT is lit |
|---|
| • This condition indicates a malfunction. When the LED is lit, the unit has turned itself off due to an over-temperature (over temp) condition or there is a problem with the internal amplifier module.
 • If this condition occurs, follow the steps below to diagnose the problem: |
| Check the fan and airflow.
 • Verify that the fan is running.
 • If the fan is running, verify that the vents are not blocked and that there are no foreign objects on or around the fan. You should be able to feel the exhaust air.
 • If there is accumulated dust or other particulates on or around the fan blades, clean the fan blades with compressed air or a directed water source.
 • If fan is not operating, contact Wavestream about fan replacement. |
| Check the over-temp signal.
 • Verify the state of the Over_Temp signal displayed on the GUI. If over-temperature; verify that the fan is running.
 • If Over_Temp is not asserted, then typically the internal amplifier has failed; send the unit to Wavestream using the RMA process. |

Appendix A – SAbus

This appendix describes the Serial Monitor and Control protocol for the serial remote control interface. The SAbus provides monitor and control capability and some flexibility not available in customized systems solutions.

General Protocol Description

The SAbus interface is a multi-drop, balanced line, asynchronous, full-duplex communications link that interconnects equipment for remote control and switching applications. SAbus compatible equipment can be linked together over a parallel-connected 4-wire circuit regardless of their particular function.

The SAbus subset of RS-422/485 allows up to 63 slave devices with one master to be connected in parallel with a maximum of 4000 feet between any master and group of slaves.
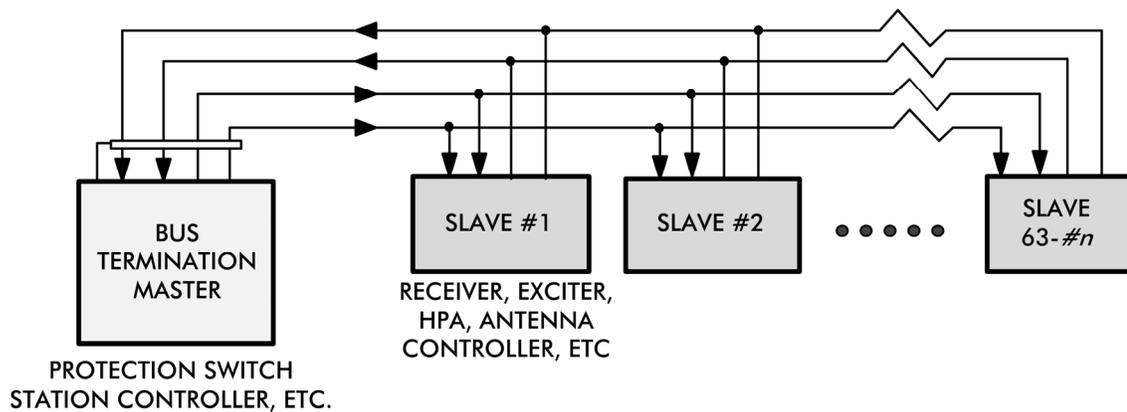
NSG378A

Each slave device is internally configured to respond to a unique address. A master could be a protection switch, earth station controller, or any microcomputer or minicomputer that is electrically and operationally compatible with the SAbus. Since the electrical specifications are very similar to EIA standards RS-422/485 and RS-449, typically any computer that meets these standards can control remote devices over the SAbus.

RS 422/485 interfaces are unipolar, balanced, 5-volt serial interfaces that connect equipment which must exchange data over considerable distances with high-noise immunity and high speed. Standard IC drivers and receivers convert RS-422/485 signals to and from TTL logic levels.

Physical Specifications

- The SAbus interface uses four data lines, circuit common, and shield
- No hardware handshaking is used in the SAbus protocol
- All SAbus devices can operate in electrical parallel with a single cable connecting all devices controlled by a master

Wavestream Modified SAbus

SAbus data format supports industry's standard asynchronous ASCII format as shown in the comparison to the Wavestream modified SAbus protocol below.

	Industry standard SAbus protocol	Wavestream SAbus Protocol
	Asynchronous ASCII	Asynchronous ASCII
Start bits	1	1
Data bits	8 (7-bit ASCII with 8th bit set to even parity	8 (no parity bit)
Stop bits	1	1

Data Format

The ASCII control character subset 00-1F (hex) are used for address, command, and data characters.

The standard bus data rate via direct connect (up to 4000 feet) is 9600 baud; the data rate for devices connected to a master via modem is 1200 baud.

Message format and protocol over the SAbus is a derivative of IBM's binary synchronous communications protocol (BISYNC).

- The master station sends a command over the bus to all remote stations

- The station whose address is contained in the second byte of the command message carries out the requested commands and then sends a response message containing its own address and status information relating to its present condition

- A remote station only sends a response following a command from the master containing its unique address. This prevents bus contention caused by more than one remote device communicating over the SAbus at the same time

- A remote device ignores all commands that contain parity or checksum errors, protocol errors, a wrong address, or message overrun errors

- A remote device replies with a not-acknowledged (NAK) character if it receives an invalid command or data

Message Format

Command messages begin with a start-of-text (STX) byte followed by a remote address, a command byte, and multiple data bytes. The end-of-text (ETX) byte is sent following the last data byte and the message is terminated by a checksum character.

COMMAND MESSAGE:

STX	ADDRESS	COMMAND	D1	D2	Dn	Dn+1	ETX	CHKSUM

RESPONSE MESSAGE: COMMAND ACKNOWLEDGED

ACK	ADDRESS	COMMAND	D1	D	Dn	Dn+1	ETX	CHKSUM

RESPONSE MESSAGE: COMMAND NOT ACKNOWLEDGED-UNABLE
TO EXECUTE OR INCORRECT COMMAND

NAK	ADDRESS	COMMAND	ETX	CHKSUM

NSG 380A

Response messages are identical to command messages in format with the exception of the acknowledge (ACK) or not-acknowledged (NAK) character at the start of the message instead of STX.

A command or reply message may vary in length; it may have a maximum of 200 bytes including delimiters and checksum. Although most currently implemented SAbus devices require no (or very few) data bytes, the capability for long messages is built into the protocol so that future applications requiring the transfer of large amounts of data can be accommodated.

Message Delimiters

- A command message begins with STX (02 hex), the ASCII start-of-text character
- A message-acknowledged reply begins with ACK (06 hex), the ASCII acknowledge control character
- A message-not-acknowledged reply begins with NAK (15 hex), the ASCII not-acknowledged control character
- All messages end with ETX (03 hex), the ASCII end-of-text control character, followed by the checksum byte

Address Character

The device address must be a valid ASCII printable character between 1 and 0, or 31 through 6F (hex); providing the possibility of 63 SAbus addresses.

Command Character

The command (CMD) character immediately follows the device address and specifies one of a possible 80 different commands for a particular device. Values from 30 to 7F (hex) are allowed. Commands may be completely device dependent with the exception of command 30 (hex), which must cause a device to return its six-character device type and command 31 (hex) which is a status poll.

Command and Reply Data

A command or device reply may contain from 0 to 128 data characters and is restricted only to printable ASCII characters 20 through 7F (hex).

Check Character

The last character of any SAbus message is the check (CHK) character. This character is simply the bit-by-bit exclusive OR of all characters in the message starting with the STX character through the ETX character. This forms a longitudinal redundancy parity check over the entire message.

Message Timing

Different devices will require different times to execute commands from a Master. A receiver, for example, may be instructed to change frequency and may require up to a second for the synthesizer to lock. This should not prevent it from immediately acknowledging the command. The NAK or ACK reply does not signify that a function has actually taken place, but only that the message was received and understood. A status reply should indicate when a device is executing a time-consuming function.

A remote device must begin responding to a command within 100 milliseconds after receiving the last character of the command and no more than 10 milliseconds must pass between each character. If the remote device does not respond within this time, the master/controller should attempt to re-establish communication by re-polling this device at least once.

At least a 10-bit time delay must be inserted between command messages in order to wake up a remote device. Once the device is awakened by data on the bus, it looks for STX followed by its address. If it does not see its own address, it ignores the rest of the message by going to sleep and remains in that state until the serial data line idles for at least 10-bit times or approximately 10 milliseconds.

All SAbus compatible devices must respond to a command 0 (30 hex), with 6 data bytes of ASCII characters in the following form:

ACK ADDR 30 D1 D2 D3 D4 D5 D6 ETX CHSUM

where D1 through D4 are four ASCII characters representing the model number and D5 and D6 are two ASCII characters representing a software version number.

If more than one command is required to obtain status information of device's functions that can cause a change bit to be set. Then the device must implement a clear change bit command and this must be the only command which causes the change bit to clear. If several commands have to be executed in order to set all the information that can cause a change bit to be set, then multiple change bits may be used to reduce the bus traffic.

Wherever possible, SAbus numeric data should be sent encoded as ASCII data characters and only in cases where it cannot be avoided, numeric data should be sent in binary or BCD packed format. Status bits in data bytes (i.e., change bits, alarm bits, etc.) should occupy no more than four bits in the low-order nibble. The high-order nibble should be set to 03 to guarantee that the byte will contain a printable ASCII character.

The slave state diagram presents the required protocol implementation at the slave device that guarantees the proper transfer and processing of communication messages sent by a master/controller over SAbus.
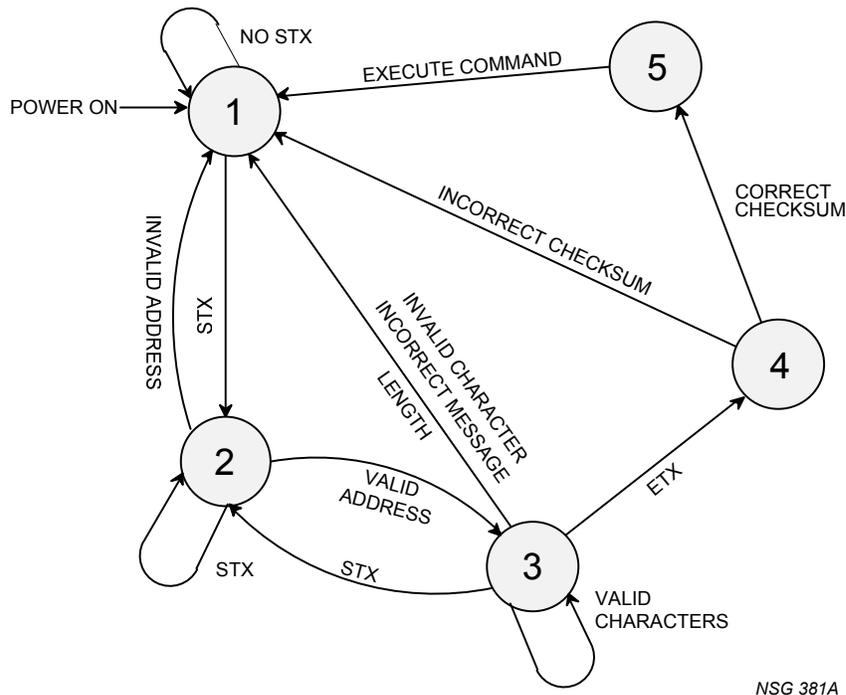
NSG 381A

State Diagram Notation

In the state diagram each state that a device can assume is represented graphically as a circle. The single-digit number in the circle identifies the state. All permissible transitions between states are represented graphically by arrows between them. Each transition is qualified by a condition that must be true in order for the transition to occur. The device will remain in its current state if the conditions which qualify transitions leading to other states are false or conditions that qualify pseudo-transitions are true. A pseudo-transition is a transition that occurs within the same state and is represented graphically by arrows leaving from and arriving at the same state.

The following mnemonics describe transitions in the state diagram.

STX	Start-of-text ASCII control character, used as a header in the SAbus command messages. It identifies the beginning of a new message.
ETX	End-of-text ASCII control character used as a termination character in SAbus messages to identify the end of data.
Checksum	The longitudinal redundancy check (LRC) byte is the last byte in the SAbus message data block. The value of the LRC byte is the exclusive OR of all message bytes including the STX and the ETX bytes and is used to detect errors during transmission of data.

The following table defines the transitions between states.

State	Name	Description
1	Device Idle State	In State 1, a device is ready to receive a new message, and therefore, must complete any previous message reception. A device always powers on in State 1. A device will exit State 1 and enter State 2 (device addressed state) only if STX byte is received.
2	Device Addressed state	In State 2, a device is waiting to receive the address byte, the second byte of the SAbus command message. A device will exit State 2 and enter: • State 3 (device data state) if received address byte equals a device's address. • State 1 (device idle state) if received address byte does not equal a device's address. • State 2 (remain in current state) if STX byte is received which may be the beginning of a new message data block.
3	Device Data State	In State 3, a device is engaged in receiving the command and associated data bytes sent by a master/controller. A device will exit State 3 and enter: • State 4 (device data error state) if ETX byte is received signifying the end of data in the message. • State 1 (device idle state) if invalid command, or data character, or incorrect number of data bytes are received.
4	Device Data Error State	In State 4, a device is waiting to receive a checksum byte which tests the transmitted message for errors. A device will exit state 4 and enter: • State 5 (command execute state) if a checksum byte is true (received LRC value of checksum byte equals LRC value computed by a device during message reception) • State 1 (device idle state) if a checksum byte is false (received LRC value of checksum byte does not equal LRC value computed by a device during

State	Name	Description
		message reception).
5	Command Execute State	In State 5, a device, having completed a reception of SAbus message, executes a device's function specified by a command byte. A device will send and appropriate response message to a master/controller within 100 milliseconds after receiving the last character of the message. A device will always exit State 5 and enter State 1 - Device Idle State.

Packet Structure

Data and information from the controller to the unit is transmitted in packets.

Response to errors:

- If the address does not match, the M&C will not respond

- If the checksum is invalid, the M&C will not respond

DEC	HEX	ABR	Char Name	
02	0x02	STX	Start of Text	
03	0x03	ETX	End of Text	
06	0x06	ACK	Acknowledge	
21	0x15	NAK	Negative acknowledge	
	0x30 to 0x39		address	One byte, typically in the range 0x30 to 0x39, but can be any value other than STX, ETX, ACK or NAK. Must match the value configured into the M&C unit or message is ignored.
	0x30 to 0xF0		Command	One byte, typically in the range 0x30 to 0xF0, but can be any value other than STX, ETX, ACK or NAK.
			Data	Up to 570 bytes of ASCII characters.
			Checksum	One byte containing the XOR of all previous bytes including STX and ETX.
			Echo Address	
			Echo Command	

ASCII Encoding of Binary Data

All binary data sent and received by the M&C is encoded into ASCII characters. If a communication protocol allows unrestricted binary data, designate a unique start, stop, ACK or NAK byte. However, since the data payload of a packet can contain bytes of any value, you are never sure if a byte is a control code, or part of the payload. If a communication is corrupted and the receiver loses track of where it is in a message, then there is no reliable way to guarantee resynchronization. In the worst case scenario, depending on the data payload, the communication might never recover synchronization.

When data is encoded into ASCII format the start, stop, ACK, and NAK codes are guaranteed to never be present in the data payload.

All binary data is encoded in hex ASCII in Intel byte order. Intel byte order, also called little-endian, because the least significant byte is first in memory. For example, if a 16-bit word contains the binary value 0x12AB, it will be stored in memory as AB12, and converted to the ASCII string AB12.

Master-Slave Communication

All communication is initiated by the Master. The M&C will never initiate communication; it will only respond. Communication is via a 4-wire RS-485. The M&C receiver is always active. The transmitter is activated to send a reply, then it is deactivated. This allows multiple units to exist in parallel.

The default address 0x30 is assigned to each unit. The unit will only respond to messages sent to this address.

Combined Status Message

The M & C responds with the entire status of the amplifier in a single communication.

Separate messages are not currently available to get individual pieces of information.

To get the unit status, use the command

```
CMD_GET_STATUS = 0x40
```

Status Message Definition

The most convenient way to use the data definitions is to use C or C++ programming language on an Intel architecture machine. The structures and bit-fields can be used directly. Pack the structures using byte alignment. Most compilers will default to WORD, DWORD or larger alignment. The compiler must be configured to pack these structures correctly.

Use the following directive for Microsoft Visual C++ V6.0:

```
#pragma pack(1)
```

Commands

Command	Hex	Notes
CMD_GET_MODEL_NUMBER	0x30	Returns the unit model number in ASCII Unit ID is an ASCII string. It is returned directly (not converted to hex).
CMD_GET_SERIAL_NUMBER	0x31	Returns the serial number in ASCII (not converted to hex).
CMD_GET_VERSION	0x32	Returns the firmware version in ASCII.
CMD_GET_STATUS	0x40	Returns the status of the amplifier in ASCII format.
CMD_GET_RAW_STATUS	0x41	Returns the status of the amplifier in hex ASCII format without calibration factors
CMD_ENABLE TRANSMITTER	0x50	Sets the TransmitSoftEnable bit. It enables the transmitter if it is not in fault mode and the two enable lines are low. If successful, the response ACK string is OK.

Command	Hex	Notes
CMD_DISABLE TRANSMITTER	0x51	Clears the TransmitSoftEnable bit. Disables the transmitter unless the override line is high. If successful, the response ACK string is OK.
CMD_SET_ATTENUATION	0x52	Sets the attenuation value to a user specified 8 bit (2 bytes) value in 2 dB increments.. If successful, the response ACK string is OK. For example: sending a 1 = 2 dB attenuation sending a 4 = 8 dB attenuation
CMD_SAVE_ATTENUATION	0x53	Saves the SET_ATTENUATION bit value to non-volatile memory
CMD_SET_LED_OFF	0x54	Follows entry of a command line, toggles the LED_OFF bit. Requires parameter of 0 or 1. 00>LED;01>LED OFF
CMD_SAVE_LED_OFF	0x55	Saves the current LED_OFF bit value to non-volatile memory.
CMD_SAVE_TRANSMITTER_ENABLED	0x56	Saves the current TransmitSoftEnable bit to non-volatile memory.

Compatibility GET_STATUS Data Structure

Command: 0x42

Byte	Name	Bit	Data Type	Notes
0	Projectid		Word	
4	DataStructureVersion		Word	
8	Parallel_Attenuator		Unsigned Char	
10	Mode		Unsigned Char	
12	Tx_Active	Bit 0	Nibble	
	Lock_Loss	Bit 1	Nibble	
	Sum_Fault	Bit 2	Nibble	
	Ext_TX_Disable	Bit 3	Nibble	
13	Over_Temp	Bit 0	Nibble	
	Fan_Fault	Bit 1	Nibble	
	Gate_Fault	Bit 2	Nibble	
	HPA_Off	Bit 3	Nibble	
14	Drain_Boost_2	Bit 0	Nibble	
	Fan_Off	Bit 1	Nibble	
	Drain_Voltage_Enable	Bit 2	Nibble	
	Override	Bit 3	Nibble	
15	Soft_TX_Disable	Bit 0	Nibble	
	Tx_Enable_Led	Bit 1	Nibble	
	Power_Led	Bit 2	Nibble	
	Drain_Boost_1	Bit 3	Nibble	
16	Reserved	Nibble	Nibble	
17	Led_Off	Bit 0	Nibble	
	Ext_Lock_Fault	Bit 1	Nibble	
	Ext_Sum_Fault	Bit 2	Nibble	
	MeasuredOverTemp	Bit 3	Nibble	
18	Drain_Current*		Int	Units in Amps
22	Fan_Speed		Int	Units in %; 100% = Full On
26	Rf_Fwd_Power*		Int	Units in dBm
30	Temp		Int	Units in °C
34	Vout_1*		Int	Units in Volts
38	Vout_2*		Int	Units in Volts

- Decimal value must be divided by ten to realize

Appendix B - Ethernet

The Ethernet interface is an alternative to the serial interface. It provides access to the same Monitor and Control (M&C) parameters that are available via the serial M&C interface. Detailed descriptions of the fields and Wavestream Graphical User Interface (GUI) are located in other sections in this manual.

There are two basic protocols used with the Ethernet interface: SNMP-based (Simple Network Management Protocol) and UDP-based (User Datagram Protocol). The SNMP-based protocol can be used to incorporate M&C for the unit into existing GUI structures. The UDP-based protocol is a simple encapsulation of the serial protocol into UDP packets which allows the Wavestream GUI to talk to the unit via Ethernet.

UDP-based Monitor & Control

The Wavestream GUI described in this manual can be used to monitor and control the unit via Ethernet. Instead of using a COM port and running over a serial link, the GUI encapsulates commands into UDP datagrams and receives response UDP datagrams from the unit. The operation of the GUI remains the same as when used over a serial link.

SNMP-based Monitor & Control

Wavestream provides a Management Information Base (MIB) for incorporation into an SNMP suite. Users with existing SNMP-based management can easily add control and status of the unit. The MIB consists of the same fields described in the Wavestream GUI. Each is presented as an Object Identifier (OID) in a hierarchical namespace or tree. Users who are interested in monitor and control of the unit via SNMP should contact Wavestream support at support@wavestream.com.

Security should be a primary concern when developing or adding SNMP-based monitor and control to prevent unauthorized access to computers and other systems on the Local Area Network (LAN).

MIB

Contact Wavestream support at support@wavestream.com.

Appendix C - Change the IP Address

Use this procedure to change the IP address. Contact Wavestream Technical Support at support@wavestream.com to obtain a copy or replacement copy of the software.

Equipment

Wavestream CD (shipped with the unit)   WavestreamGUI.exe
                                               XportSetup-25.exe

DeviceInstaller (free download from   DeviceInstaller.exe
www.lantronix.com)

Procedure

> ### N o t e
>
> *A correctly connected unit with power and Ethernet connectivity is assumed prior to changing an IP address.*
>
> *Antivirus software and/or firewalls may interfere with the installation of Wavestream software.*
>
> *Consult an IT specialist if needed.*

Ethernet Connection

1. Insert the Wavestream CD. Open the folder containing the DeviceInstaller.exe or obtain the latest version from www.lantronix.com.

2. Run **DeviceInstaller.exe**, it will self install.

3. Click **Search** to search for the connected unit. The device installer will locate any devices on the network.

   It may ask for the MAC address of the unit. The MAC address is located on the unit label.

   Enter the MAC address, the unit will be located and the IP address displayed.
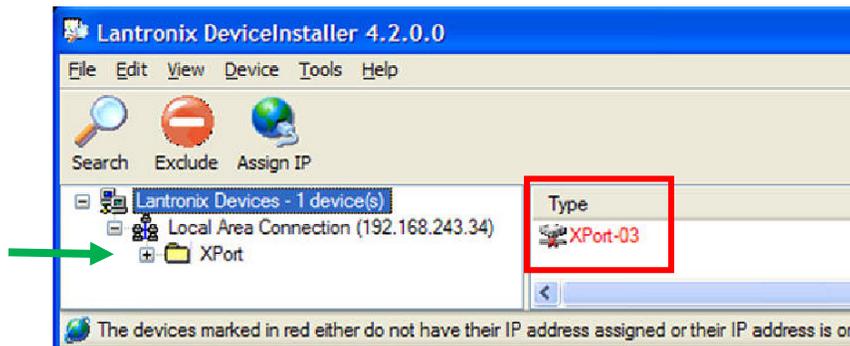

ip1a

   If the unit is displayed in red with a status of `unreachable;` determine if the unit is set to an IP domain different from the network/PC. It may take a few minutes to display after cycling power.

4. Expand the **Xport → X Port-03 – firmware v1.00** directories**.**

5. Select the unit IP address. Click it for details. This will display the IP address, Subnet Mask and other information for the unit.
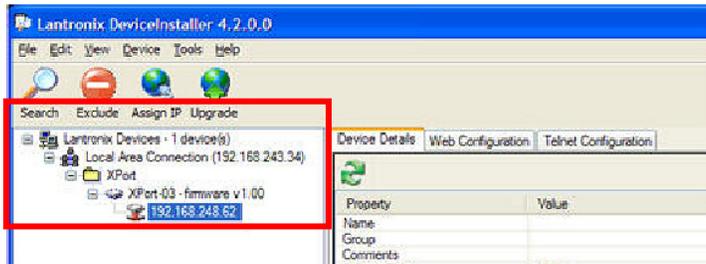
ip2a

6. Click **Assign IP** on the menu bar.
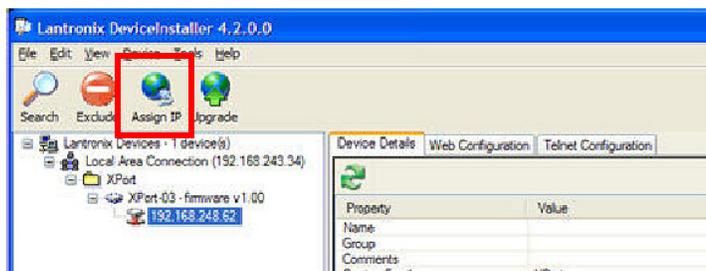
ip3a

7. Select **Assign a specific IP address**, click **Next**. By assigning a specific IP address, the address will remain fixed and will not change.
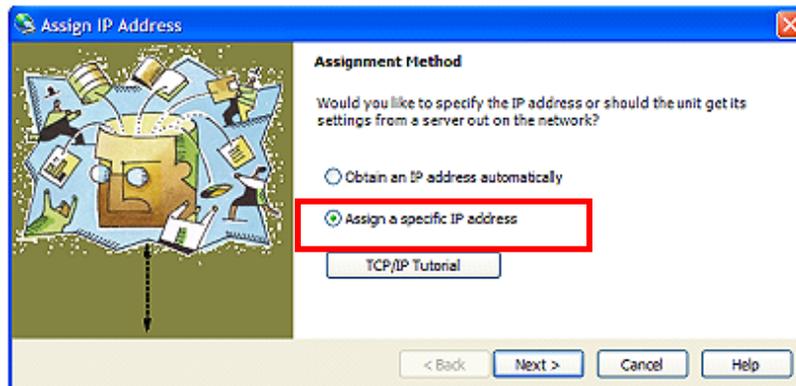
ip4a

8. Enter the appropriate IP address and subnet mask, click **Next**.
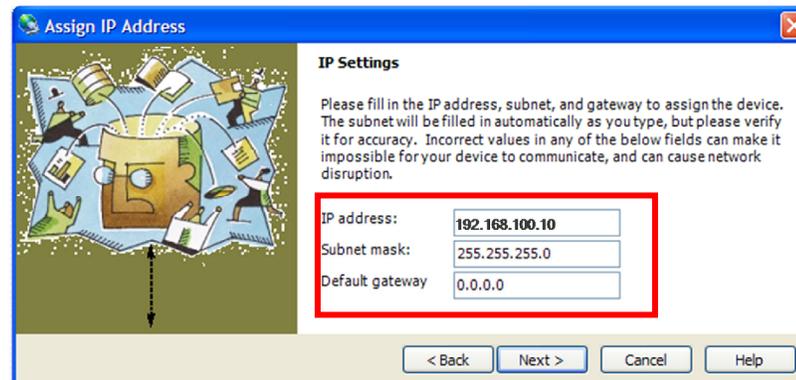
ip5a

9. Click **Assign**.

ip6a

10. Click **Finish**. Wait while the unit completes the IP address assignment.

ip7a

11. If you receive any error messages or the unit does not resume communication and or regain connectivity, contact Wavestream Technical Support at support@wavestream.com.

Appendix D - Glossary

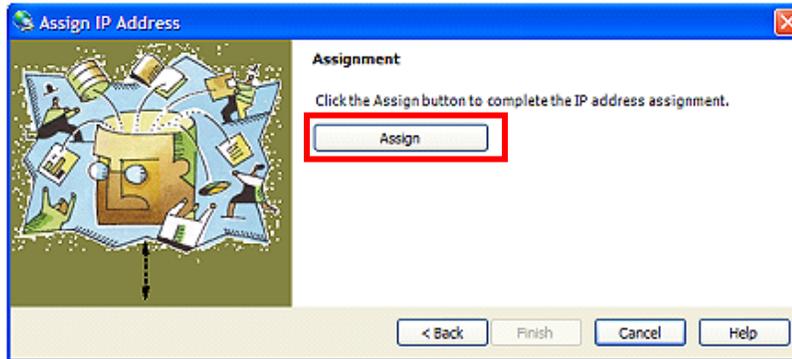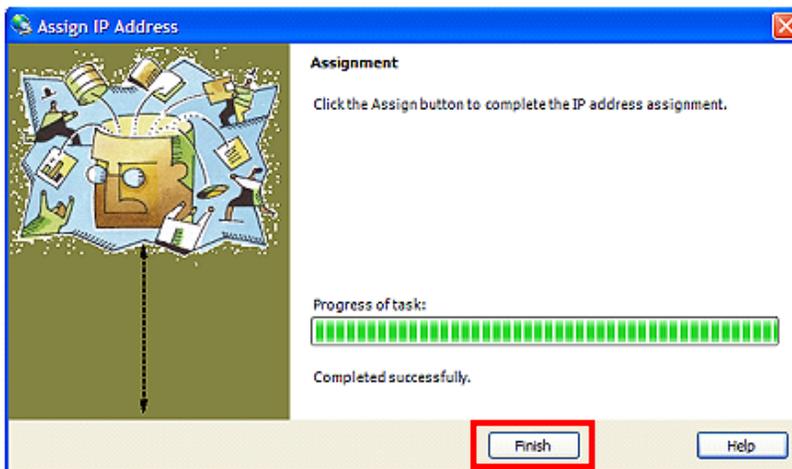|	Description
ACK	Acknowledge
BUC	Block Up Converter. In the transmission or uplink of satellite signals, a BUC on an antenna converts a band or block of frequencies from a lower frequency to a higher frequency on a Ka, Ku, or C band satellite.
cmd	command
dBc	dBc (decibels relative to the carrier) is the power ratio of a signal to a carrier signal, expressed in decibels.
dBm	dBm (sometimes dBmW) is the power ratio in decibels (dB) of the measured power referenced to one milliwatt (mW).
endian	The ordering of individually addressable sub-units (words, bytes, or even bits) within a longer data word stored in external memory. The usual contrast is between *most* versus *least* significant byte first, called big-endian and little-endian respectively.
ESD	Electrostatic discharge
ETX	End of text
FET	Field Effect Transistor
GFI	Ground fault interrupt
GUI	Graphical User Interface
IF	intermediate frequency
IFL	Interfacility link
LRC	longitudinal redundancy check
M & C	Monitor and Control
NAK	Not acknowledged
OQPSK / QPSK	Offset quadrature phase-shift keying (OQPSK) is a variant of phase-shift keying modulation using 4 different values of the phase to transmit.
RF	Radio Frequency
RMA	Return Material Authorization
RS-422	This standard specifies voltages and impedance levels on balanced line interconnections. The data is transmitted on a twisted pair of wires (4 wires on a full duplex system).
RS-485	RS-485 defines a system for interconnecting several data terminals to a common twisted pair balanced line. The interconnection is similar to RS-422, but all of the connected devices listen with their transmitters off.
SAbus	Communications protocol connecting equipment for remote control and switching applications. SAbus compatible equipment can be linked together over a parallel connected 4-wire circuit without regard to function.
SSPA	Solid-State Power Amplifier
STX	Start-of-text

	Description
UPS	Uninterruptible Power Source
VSWR	Voltage Standing Wave Ratio. The ratio between the minimum and maximum voltage on a transmission line, cable, waveguide, or antenna system.
waveguide	A structure which guides waves, such as electromagnetic waves or sound waves.

Appendix E - AC/DC Converter Power Supply (MBP-000300-xxxx)

The power supply provides AC power to the unit and a convenient through-port for the signal cable. This optional accessory may be purchased from Wavestream.

ku55

Prime

Prime Power	90 – 264 VAC, 50-60 Hz, single phase
VDC	48 VDC
Current	15 A circuit or greater
Power	300 W
Efficiency	Better than 90%

AC Prime Power Requirements

Voltage	90 – 264 VAC, single phase
Current	15 A circuit or greater

	⚠ **C A U T I O N**
	Grounding. Do NOT run on a Ground Fault Interrupt (GFI) circuit. It is advisable to run unit off a circuit with no ground fault interrupt (GFI). The unit is high power and has a number of decoupling capacitors for noise that connect to ground. There may be enough current on the ground to trip a sensitive GFI circuit.

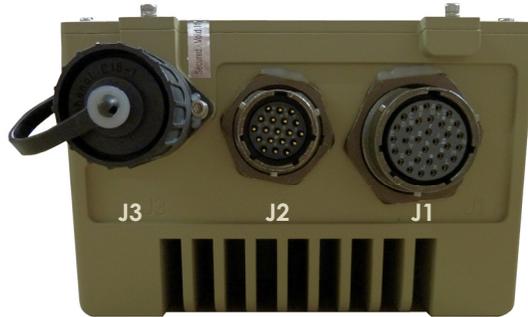## Environmental

Operating Temperature, ambient	-40ºC to +60ºC (-40°F to +140°F)
Weatherization	IP-54

Mechanical

Size	5.4" W x 3.5" H x 9.1" L (138mm W x 89 mm H x 231 mm L)
Weight	6.1 lbs (2.8 Kg)

System Description

Connector Side

ku53

Connector Name	ID	On Unit	Mating Connector to User System*	
M & C and Power Output Connect AC power supply to BUC	J1	32-pin female	Connector: ITT Cannon MS3126F14-17S Wavestream cable P/N: 02-009-0091: 4ft cable Wavestream cable P/N: 02-009-0092: 8ft cable	
		12-pin female	Connector: Pei Genesis KPT06UT14-12S Wavestream cable P/N: 02-009-0144: 4ft cable	
M & C Monitor & Control Input Connect AC power supply to customer equipment	J2	19-pin male ITT Cannon MS3126F14-19S	Connector: ITT Cannon DEMAM9P Wavestream cable P/N: 02-009-0093	
AC Input Connect to AC prime power *Included with power supply*	J3	4-pin male Connector P/N: Amphenol CD16 20D003 110 12	AC cable Wavestream cable P/N: 02-009-0094	

*The AC input cable is provided; other cables may be built by the user or purchased from Wavestream.

⚠	⚠ **W A R N I N G**
	Wiring.
	Incorrect cable wiring can permanently damage this unit.

Document Number: 90-005-0013_F

Front

PRESSURE VENT
(do not remove)

ku51

Installation

Preparation

Required Tools / Supplies

- Screwdrivers
- Cable manufacturing tools

Installation Precautions / Prerequisites

	⚠ C A U T I O N
🚫💧	**Moisture sensitive.** Tightly connect and seal the RF input, power, and M & C connections against moisture using good commercial practice and UV-rated materials.

Inspection and Unpacking

- Keep the shipping box and all packing materials for future use, including return of the unit for repair.
- Inspect the unit for any visible damage. If the unit is damaged, follow the warranty RMA procedure.
- Inspect the waveguide and remove any foreign objects such as packing material.
- Verify that the connector pins on the rear are intact and ready for connection.

Mounting

> **N o t e**
>
> *Use the correct length mounting hardware screws. If the screw length is excessive it will damage the equipment.*

1. Install the power supply according to standard practice.
2. There are four mounting points, two on each side of the unit. Use a ¼ - 20 screw that protrudes no further than 0.30" into the unit.
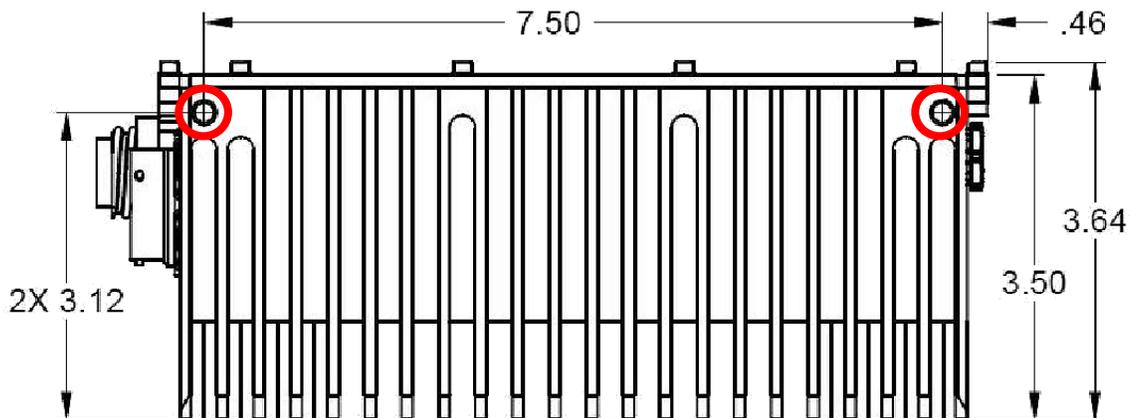
3. Connect J1, from the power supply to the BUC.
4. Connect J2, the M&C connector to the network.

> **N o t e**
>
> *The monitor and control signals are passed through the AC/DC Converter Power Supply to/from the MatchBox.*

5. Connect J3, AC Prime Input connector to the Prime AC power source. The unit should power on.

Installation

RS-485

OPTIONAL AC POWER SUPPLY

BUC

J3   J2   J1

1   2   3

5

8

7

AC
OUTLET

9

4

Wavestream #: 02-012-0009
USB to RS-485 adapter
B&B Electronics
(485USB9F-4W)

10

CONTROLLER

Equivalent Connectors

1	4-pin mating connector Wavestream #: 06-005-0238 Amphenol CD16 20D003 110 12
2	19-pin mating connector Wavestream #: 06-005-0236 ITT Cannon MS 3126F14-19S
3	32-pin mating connector, male Wavestream #: 06-005-0388 Pei Genesis KPT06UT18-32P
4	D-sub 9-pin mating connector, male Wavestream #: 06-005-0035 ITT Cannon DEMAM9P
5	32-pin mating connector, female Wavestream #: 06-005-0261 Amphenol MS3126F18-32S

OPTIONAL Cables
(available from Wavestream)

7	AC Power Cable Wavestream #: 02-009-0094 10 feet – included
8	M & C Cable Wavestream #: 02-009-0092 8 feet M & C Cable Wavestream #: 02-009-0091 4 feet
9	M & C Cable Wavestream #: 02-009-0093 10 feet
10	USB-A to USB-B Cable Wavestream #: 02-009-0163 3 feet

setup1

Ethernet

OPTIONAL AC POWER SUPPLY

J3 J2 J1

BUC[16W, 25W. 40W]

AC OUTLET

RJ-45

To network connection

Not required if Ethernet control is used

02-012-0009
USB to RS-485 adapter
B&B Electronics
(485USB9F-4W)

Network connection

CONTROLLER

Equivalent Connectors	
1	4-pin mating connector 06-005-0238 – included with unit Amphenol CD16 20D003 110 12
2	19-pin mating connector 06-005-0236 ITT Cannon MS 3126F14-19S
3	32-pin mating connector, male 06-005-0388 Pei Genesis KPT06UT18-32P
4	D-sub 9-pin mating connector, male 06-005-0035 ITT Cannon DEMAM9P
5	12-pin mating connector, female 06-005-0390 Pei Genesis KPT06UT14-12S
6	32-pin mating connector, female 06-005-0261 Amphenol MS3126F18-32S

OPTIONAL Cables (available from Wavestream)	
7	AC Power Cable Wavestream #: 02-009-0094 10 feet – included
8	M & C Cable Wavestream #: 02-009-0092 8 feet M & C Cable Wavestream #: 02-009-0091 4 feet
5	M & C Cable Wavestream #: 02-009-0144 4 feet
10	USB-A to USB-B Cable Wavestream #: 02-009-0163 3 feet
11	M & C Cable Wavestream #: 02-009-0093 10 feet
12	M & C Cable with Ethernet breakout Wavestream #: 02-009-0189 10 feet

setup2

Maintenance & Service

Frequency	Inspection to perform	Description
6 months	Equipment and connections	Inspect the equipment and connections. Verify that they are corrosion-free and secure.
6 months	Connectors	Remove any corrosion build up. Verify they are securely connected.

Revision History

Rev	ECO Number	Brief Description	Requestor	Date
A	-	New	G. Echo	9-Apr08
B	08-035	Inc per ECO*	E. Hartmann	1-May-08
C	08-274	Inc per ECO*	G. Echo	11-Aug-08
D	08-338	Inc per ECO*	C. Deckman	2-Oct-08
E	08-387	Inc per ECO*	G. Echo	20-Nov-08
F	09-273	Inc per ECO*	D. Nakhla	7-27-10

*Complete revision history is in Omnify