



**Model 142-6150  
ANTENNA DOWN/UP CONVERTER**

**SERIAL NUMBER \_\_\_\_\_**

**May 24, 2000  
Revision N/C**

# FCC Notice and Compliance Statement

**Model:**                **Fiber Optic Modules, 150-702-1**  
                              **Fiber Optic Modules, 150-704-1**  
                              **XL-AK GPS Receiver, 600-000**  
                              **XL-AK GPS Receiver, 600-100**  
                              **XL-AK GPS Receiver, 600-101**  
                              **Network Time Server, NTS-200**  
                              **Antenna Down\Up Converter, 142-6150**

## FCC Notice

This device has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This device generates, uses, and can radiate radio frequency energy and, if installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this device does cause harmful interference to radio or television reception, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the computer and receiver.
- Connect the computer into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Caution: Any changes or modifications not expressly approved by the grantee of this device could void the user's authority to operate the equipment.

## FCC Compliance Statement

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.



# DECLARATION OF CONFORMITY

In accordance with ISO/IEC GUIDE 22 and EN 45014

TrueTime, Inc.  
2835 Duke Court  
Santa Rosa, CA 95407 USA

Declares that the

## **Antenna Down/Up Converter Model 142-6150**

### **CONFORMS TO THE FOLLOWING EUROPEAN DIRECTIVES:**

Low Voltage Directive 73 / 23 / EEC  
Low Voltage Directive Amendment 93 / 68 / EEC  
EMC Directive 89 / 336 / EEC

Safety: IEC 950:1991 + A1:1992 + A2:1993 + A3:1995 + A4:1997  
EN 60950 (1997) A1, A2, A3, A4

EMC: EN 50082-1 (1997)  
EN 55022 Class B (1995)

Issued: April 28, 2000 at TrueTime, Inc., Santa Rosa, CA, USA

I declare that the equipment specified above conforms to the above Directives and Standards.

4-28-00

Daniel Koff

ME Man

Date

Name

Title

Signature

European Representative: \_\_\_\_\_

Company Name and Location

Date

Name

Title

Signature

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# 1 General Information

## 1.1 Introduction

An antenna down/up converter is provided when signal losses in the antenna cable limit the distance between the receiver and the antenna assembly. Many applications requiring cable lengths to 1500 feet will benefit from the use of a down/up converter assembly. At just over 250 feet in cable length, the benefits can be realized using a down/up converter assembly versus the use of low loss cable and amplifiers. Signal strengths and noise immunity are the main advantages of using the antenna down/up converter assembly, as well as the cost benefits over the use of low loss cable and amplifiers.

The GPS receiver, when shipped with the optional antenna down/up converter, is configured to provide the appropriate DC power (+12 VDC) for the antenna down/up converter assembly.

## 1.2 Antenna Down Converter Specifications

### 1.2.1 Physical Specifications

Antenna Down Converter Size: 4.4 in diameter x 2.1 in tall  
(11.17 cm diameter x 6.85 cm tall)

Note: The Antenna Down Converter Unit is mounted on a 12-inch long PVC mast with a 3/4-inch Male Pipe Thread (MPT) on both ends. The above-specified overall lengths of the Antenna Down Converter Units are therefore increased by approximately 11.25 inches when the mounting mast is included.

Antenna Down Converter Weight  
(including mounting mast): 0.60 lb (0.272 kg)

Antenna Down Converter  
Cable, RG-58: Available lengths = 50 - 1500 ft (see table below)  
2.7 lb (1.23 kg) per 100 ft  
Recommended: Belden 8219 or Belden  
Plenum 88240

Cable Length	Part Number
50 feet RG-58	142-6150-50
250 feet RG-58	142-6150-250
500 feet RG-58	142-6150-500
750 feet RG-58	142-6150-750
1000 feet RG-58	142-6150-1000
1250 feet RG-58	142-6150-1250
1500 feet RG-58	142-6150-1500

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## 1.2.2 **Operating Specifications**

Down Converter Power: +12 VDC @ 135 mA  $\pm$ 10%  
LO Frequency: 16.368 MHz @ 1 Vp-p  
IF Frequency: 4.092 MHz @ 1 Vp-p  
Antenna Frequency (L1): 1575.42 MHz  
Code: Coarse Acquisition (C/A) Code

## 1.2.3 **Antenna Rotation Coverage**

Rotation Angle	Signal Strength
0 degrees	4.0 dBic
75 degrees	-1.0 dBic
90 degrees	-3.0 dBic

## 1.2.4 **Down Converter Connection**

I/O Connector: Female TNC

## 1.2.5 **Environmental Specifications**

Operating Temperature: -40° to +70°C (-40° to +158°F)  
Storage Temperature: -55° to +85°C (-67° to +185°F)  
Humidity: 100%, condensing

## 1.3 **Antenna Up Converter Specifications**

### 1.3.1 **Physical Specifications**

Up Converter Size: 6.8 in long x 4.2 in wide x 1.8 in tall  
(17.27 cm long x 10.67 cm wide x 4.57 cm tall)

Note: The Up Converter Unit has a mounting flange with four holes for mounting purposes. The above-specified width does not include this flange. See Figure 1-1 for flange measurements.

Up Converter Weight: 1.5 lb (0.680 kg)

Up Converter Cable, RG-59: 3 ft (optional to 20 ft)  
Recommended: Belden 9104 or Belden  
Plenum 9104P

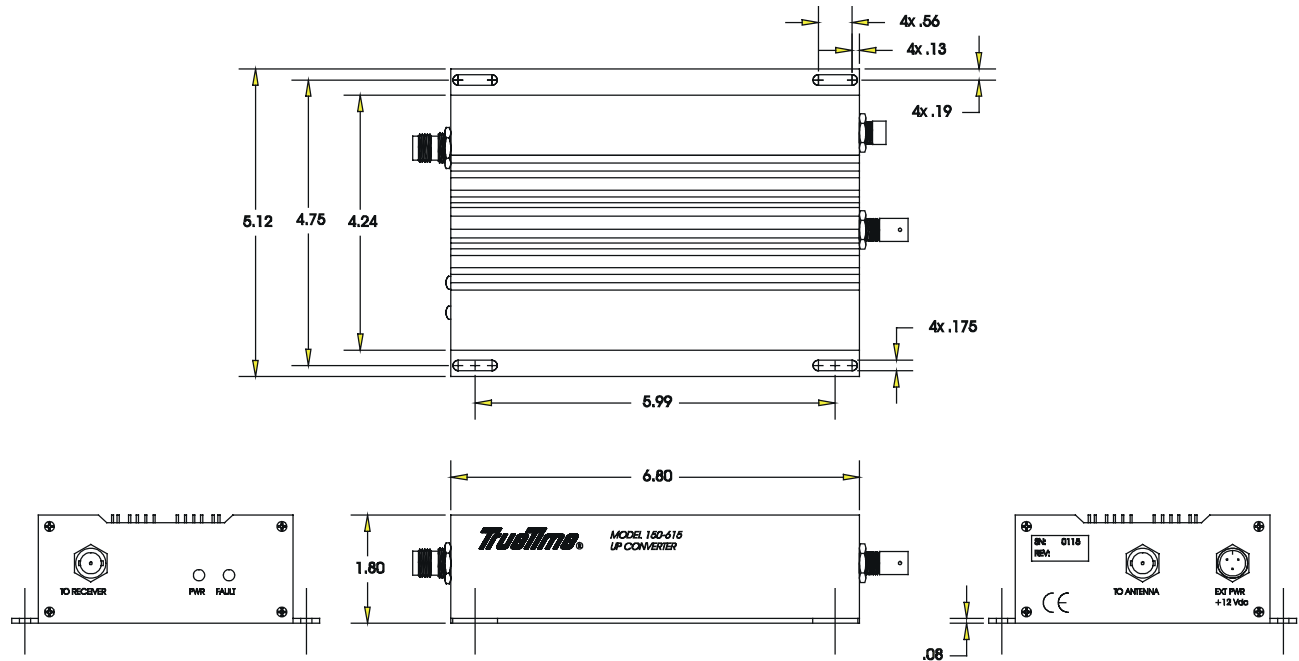


Figure 1-1 Up Converter Measurements with Flange

### 1.3.2 Operating Specifications

Up Converter Power:	+12 VDC @ 200 mA $\pm$ 10% including Down Converter
Input LO Frequency:	16.368 MHz @ 1 Vp-p received from the Down Converter
Input IF Frequency:	4.092 MHz @ 1 Vp-p received from the Down Converter
Output Frequency (L1):	1575.42 MHz
Output Code:	(C/A) Code

### 1.3.3 Environmental Specifications

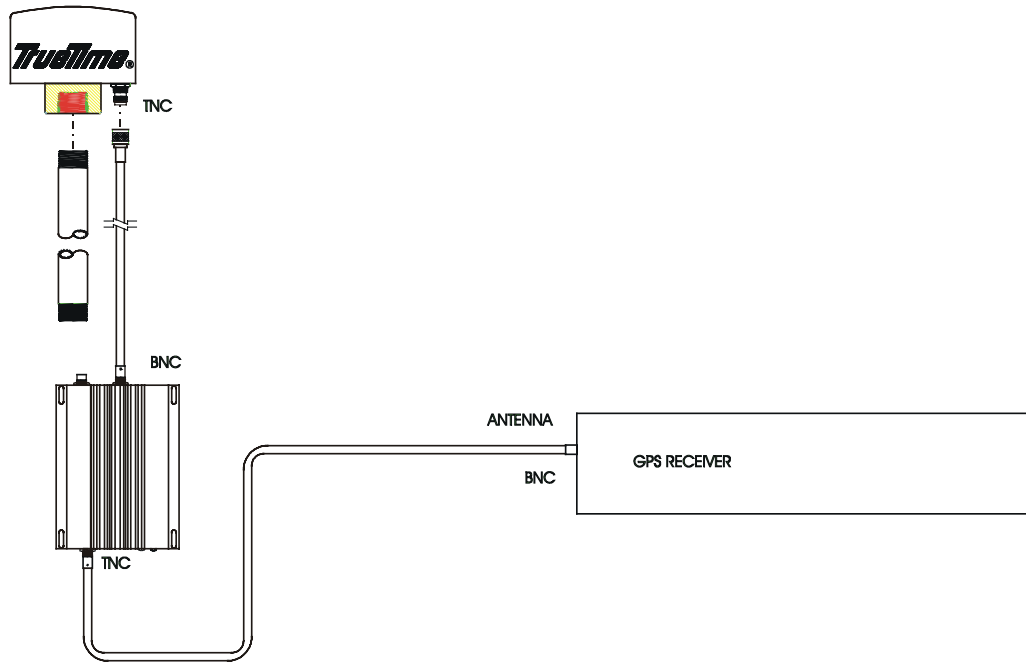
Operating Temperature:	0° to +50°C
Storage Temperature:	-40° to +85°C
Humidity:	95%, noncondensing

### 1.3.4

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### ***Up Converter Connection***

To Antenna:                      Female BNC  
To Receiver:                      Female TNC



*Figure 1-2 Down Converter to Up Converter to Receiver Connections*

### **1.3.5**



## Alternate Power Input

The system will operate from 12 V  $\pm$ 10%, supplied by the receiver, via the coaxial cable center conductor and shield connection. Alternatively, power may be supplied with following pin-out:

Pin Number	Function
1	+12 V
2	+12 Return
3	Spare

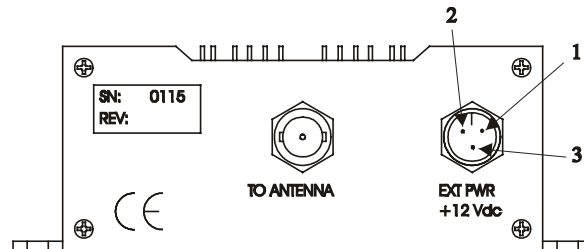


Figure 1-3 Up Converter Pin Numbers for External Power

### Optional Power Supply (088-010-1)

External Power Supply Size: 5.38 in long x 2.63 in wide x 1.5 in tall  
(13.65 cm long x 6.67 cm wide x 3.81 cm tall)

Input: 100-240 VAC, 47-63 Hz  
DC Output: +12 VDC/2.1 A  
Power: 25 W max.

Mate connector type: Micro-Con-X<sup>®</sup> 372-035CX

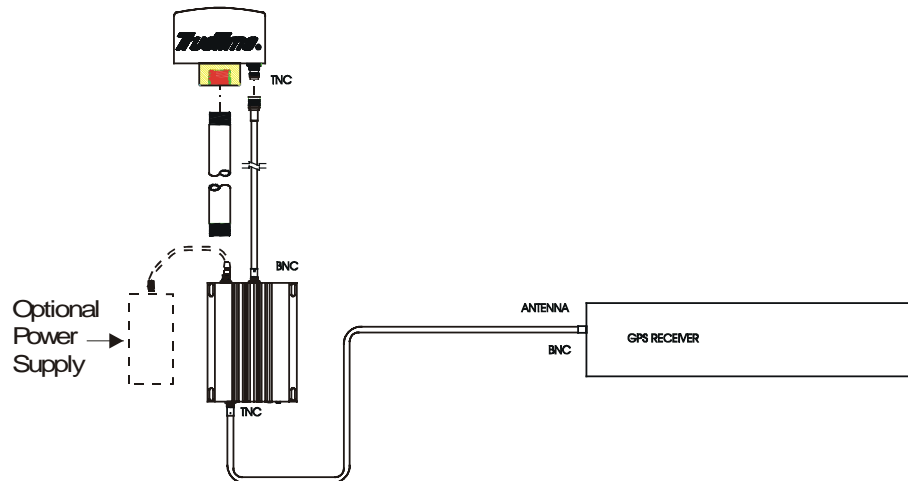


Figure 1-4 Optional Power Supply Connected to Up Converter

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When power is supplied via the external power connector, the system will draw at least 20 mA from the coaxial cable supplied power to enable the receiver to correctly detect the presence of the attached system.

Maximum time from power-on to stable operation is less than 2 minutes.

### 1.3.6 **Noise and Gain**

System Noise Figure: < 4 dB  
Overall Gain: 35 to 45 dB

### 1.3.7 **Output Signal Level**

-90 dBm  $\pm$ 10 dBm at GPS L1 frequency to receiver

### 1.3.8 **Failure Mode Current Detection**

A few installation errors or faults may occur. Users are notified of these faults via measurement of the power supply. The following scheme is used:

Condition	12 VDC Current in Coax	
	Internal (clock coax) Power	External Power
Fault Condition (detected at the clock)		
Normal	200 mA $\pm$ 10%	20 mA $\pm$ 10%
Shorted Down Converter	100 mA $\pm$ 10%	60 mA $\pm$ 10%
Open Down Converter	60 mA $\pm$ 10%	60 mA $\pm$ 10%

### 1.3.9 **Power / Fault LED**

Condition	Power LED	Fault LED
Normal	On (Green)	Off
Down/Up Converter Fault	On (Green)	On (Red)
Open/Short Down Converter	On (Green)	On (Red)

## 1.4

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## Antenna Cable Delay Entry

When the Down/Up Converter antenna is used, **660 ns** should be **added** to the cable delay entered.

Precise time clocks requiring  $\pm 150$  ns accuracy will also require a fixed delay to compensate for the antenna cable. *Positive delays entered will advance the timing outputs while negative delays will retard them.* Antenna cable delay should be added as a positive number, at 1.3 ns/ft.

## 1.5 Limited Warranty

Each new product manufactured by TrueTime is warranted for defects in material or workmanship for a period of one year from the date of shipment ("Limited Warranty"). Defects in material or workmanship found within that period will be replaced or repaired, at TrueTime's option, without charge for material or labor, provided the customer returns the equipment, freight prepaid, to the TrueTime factory under this limited warranty. TrueTime will return the repaired equipment, freight prepaid, to the customer's facility. This one-year Limited Warranty does not apply to any software or to any product not manufactured by TrueTime. If on-site warranty repair or replacement is required, the customer will be charged the then-current field service rate for portal-to-portal travel time plus actual portal-to-portal travel charges. There is no charge for on-site warranty repair labor.

Products not manufactured by TrueTime but included as integral parts of a system (e.g. peripherals, options) are warranted for 90 days or longer, as provided for by the original manufacturer, from the date of shipment. Aside from the Limited Warranty set forth above, TrueTime makes no other warranties, express or implied, of merchantability, fitness for purpose or of any other kind of description whatsoever.

By purchasing any product manufactured by TrueTime, the buyer consents to and agrees with TrueTime that as a result of the exclusion of all warranties, expressed or implied, or merchantability, fitness for purpose, or otherwise, except for the limited one-year warranty for defects in material and workmanship for products manufactured by TrueTime, that the Buyer has the sole responsibility to assess and bear all losses relating to (1) the ability of the product or products purchased to pass without objection under the contract description among merchants and buyers in the trade; (2) the conformity of the product or products to fair average quality within its contract description; (3) the fitness of the product for the ordinary purposes for which such product is used; (4) the consistency of quality and quantity within each unit of product or products and among all units involved; (5) the adequacy of containers, packaging and labeling of the product or products; (6) the conformity of the product, promises or affirmations of fact (if any) made on its label or container; and (7) the conformity of the product to standards of quality observed by other merchants in the trade with respect to products of similar description.

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## **1.6 Limitation of Liability**

By purchasing any product from TrueTime the Buyer consents to and agrees that the Buyer's sole and exclusive remedy for any damages or losses incurred by the Buyer as a result of TrueTime's breach of its one-year Limited Warranty for defects in materials and workmanship or otherwise in connection with any claim respecting the product shall be limited to the repair or replacement of the product or a refund of the sales price of the product.

In no event shall the Buyer be entitled to recover consequential damages or any other damages of any kind or description whatsoever.

## **1.7 Proprietary Notice**

This document, whether patentable or non-patentable subject matter, embodies proprietary and confidential information and is the exclusive property of TrueTime, Inc. It may not be reproduced, used, or disclosed to others for any purpose except that for which it is loaned and it shall be returned upon demand.

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## 2 GPS Down/Up Converter Antenna Installation

### 2.1 General Information

The GPS Synchronized Receiver operates on the L1 (1575.42 MHz) signal and the C/A code (1.023 MHz bit rate) with a minimum signal level of  $-162.0$  dBW and a maximum signal level of  $-137.0$  dBW. The system supplied is designed to provide the proper signal levels to the receiver.

### 2.2 Lead-in Cable

The Down/Up Converter Antenna is designed to operate with up to 1500 feet of RG-58 coax cable (BNC-TNC) connected from the up converter to the down converter. Also supplied with the Down/Up Converter Assembly is a 3-foot RG-59 coax cable (BNC-TNC). The up converter should be located near the GPS receiver using this 3-foot cable. If required, the distance between the up converter and the receiver can be lengthened to 20 feet or reduced to 1 foot using appropriate-length cables.

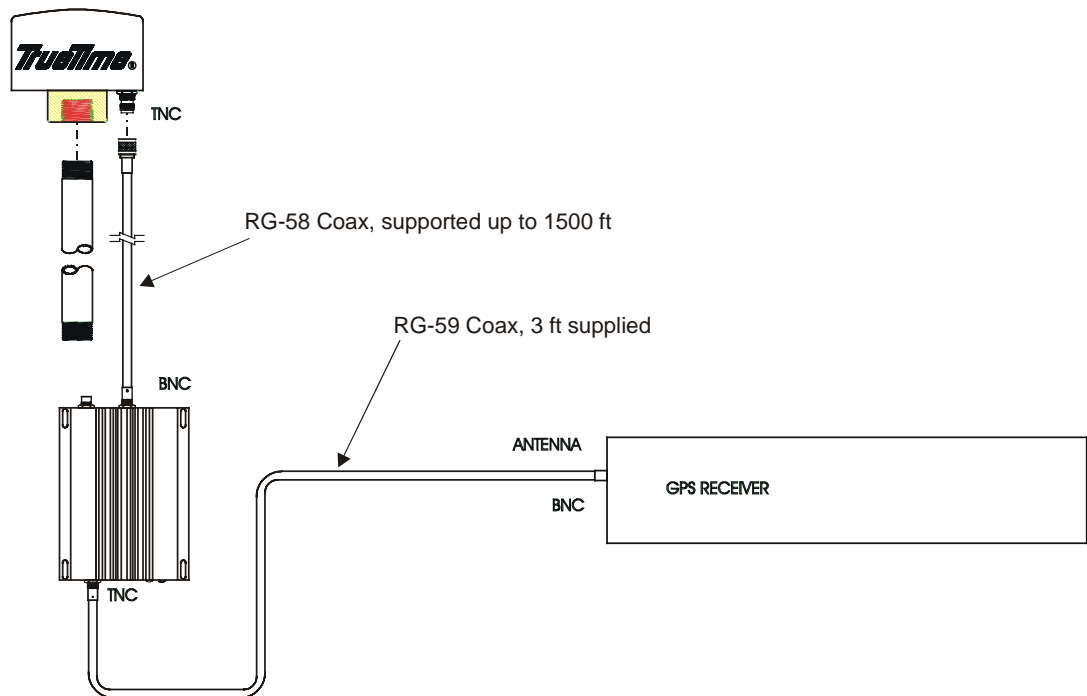


Figure 2-1 Cabling

## 2.3 Up Converter Installation

After determining the appropriate placement of the up converter, secure it properly. Use minimum No. 8 screws and anchors of minimum 3/4 inch length when mounting the plate to plaster board surfaces. For other types of surfaces, use suitable screws and fasteners to secure the up converter.

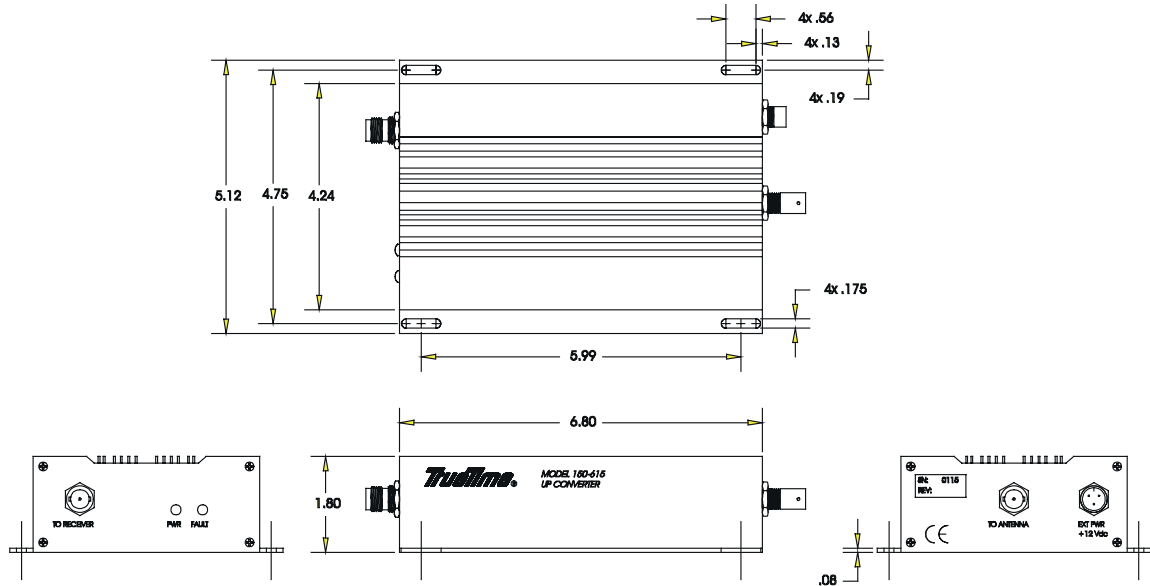


Figure 2-2 Up Converter with Mounting Flange

## 2.4

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## Antenna Installation and Location

When selecting a site for the antenna, you should find an outdoor location that provides full 360-degree visibility of the horizon. In most cases, this means locating the antenna as high as possible. Any obstructions will degrade unit performance by blocking the satellite signal or causing a reflection that cancels some of the signal. Blocked signals can significantly increase the time for satellite acquisition.

Mounting brackets are provided to mount the antenna to a pole or the peak of a building. One of the easiest ways to mount the antenna is with a pipe that has an inside diameter greater than one inch. Connect the antenna and fasten the pipe to a convenient part of the building.

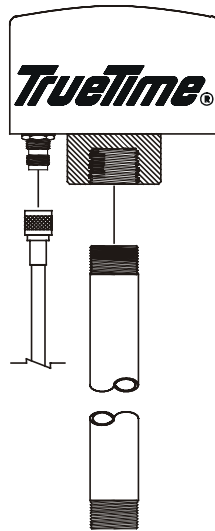


Figure 2-3 Antenna Components

## 2.5

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## Mast Mounting

Mast top mounting is the preferred mounting method. The antenna mounting mast should be 2-inch threaded water pipe or conduit. The pipe must be rigid and able to withstand high winds without flexing. Guy wires may be used to stabilize a pipe longer than 10 feet.

Multipath interference is caused by reflected signals that arrive at the antenna out of phase with the direct signal. Reflective interference is most pronounced at low elevation angles from 10 to 20 degrees above the horizon. The height of the mast may be extended to prevent multipath interference. The antenna should be at least 1.0 m from a reflecting surface.

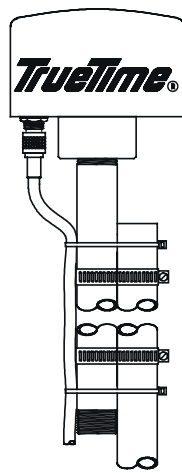


Figure 2-4 Mast Mounting

## 2.6 Additional Considerations

### 2.6.1 Building Site

The building should be located away from potential sources of interference such as RF and microwave transmission towers or areas that have signals in the 1575 MHz range. Realize that adjacent buildings, mountains or hills can block part of the horizon and limit satellite visibility in that direction or cause reflected signals.

### 2.6.2 Building Preparation

Include provisions for routing the antenna cables from the antenna locations (roof) to the up converter and receiver using as short and uniform a cable length as possible. Prior to installation, label the cable with a unique identifier and place the label at each end of the cable. All cable raceways and chases should have sufficient clearance to allow for expansion or maintenance at a later date.



### 2.6.3 Optional Lightning Arrestor (140-017)

The optional lightning arrestor is used in installations when isolated grounds are necessary to avoid ground loop problems. The unit grounds the coax shield only during surge events when the voltage difference between shield and local ground are greater than 90 V.

The lightning arrestor is capable of 18,000 amps maximum surge (IEC 1000-4-5 8/20  $\mu$ s waveform), and has a frequency range of DC to 30 MHz @ 1:1 VSWR. The turn-on voltage from center pin to connector shield is approximately  $\pm 19$  V.

#### Installation

The lightning arrestor must be installed between the down converter and up converter. The arrester should be mounted near the up converter. The mounting flange must be free of oxidation and mounted to a low-impedance ground using the hardware provided.

Connections on the lightning arrestor are TNC-TNC. Cables are required to connect the lightning arrestor to the down/up converter. These cables can be configured by the customer on site, or requested at the time of order.

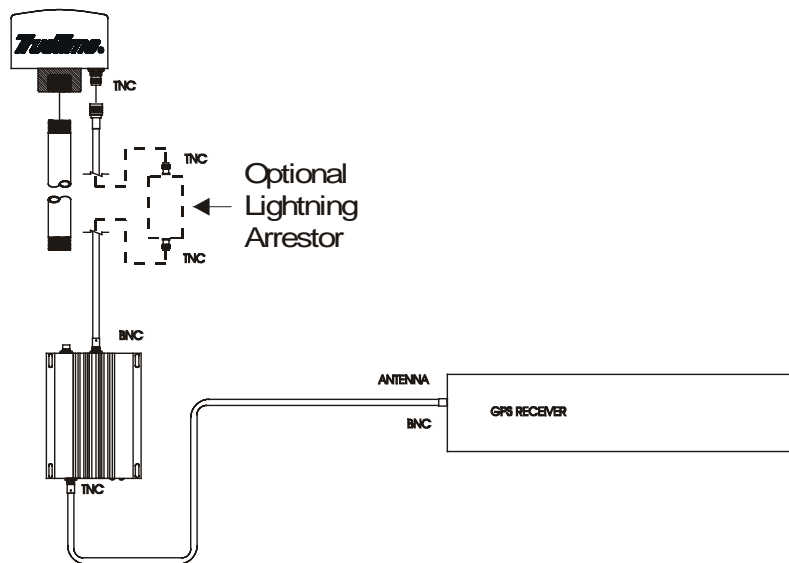


Figure 2-5 Optional Lightning Arrestor Connected Between Down Converter and Up Converter