



**TM1000A**

**GPS Based Network Time Server**

**Installation and Operation Manual**



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## 1 Introduction

The Time Machines GPS Network Time Server is a simple to use GPS based time server that will supply accurate time for all computers and time keeping devices on the network. By placing a time server on the local network, (S)NTP time packets are provided without requiring systems to go to the Internet to get a Stratum 1 time synchronization. The system uses an active GPS antenna to maintain the current time as broadcast by United States GPS satellites. With this device installed on your local network, there is no longer the worry that if the Internet connection goes down, time synchronization is lost across the network.

The unit is small and can be placed anywhere within the network layout. The built in high sensitivity GPS receiver is able to lock multiple satellites from within many buildings or from a window location, removing the requirement that outdoor antennas be installed.

Setup and use of this time server is straightforward. Simply connect both the included power supply and the GPS antenna to the base unit and then connect the base unit to the local network. Go to a computer on the network and browse to the device at its default address to enter the software setup within the control box. Set parameters to match your network and the system will start to send out time packets to any device on the system that asks for an update from it. Two servers can be setup to provide redundancy and more capacity.

When paired with our digital Power Over Ethernet (PoE) clocks, synchronized time is assured no matter the state of your network, or the state of the internet time server the clocks are pointed to. Accuracy is also improved because the network delay of the internet is highly variable, while the local LAN connection is likely sub-millisecond delay.

TimeMachine GPS based time servers are suited to any application where coordination of events at multiple locations is required. Without coordinated network time, searching for problems across multiple system logs becomes much more difficult. Education, industrial facilities, military installations, public safety command rooms, government, broadcasting, and hospitals are all candidates for synchronized time systems.

### 1.1 Serial Number Notes:

The TM1000A has been in the market a number of years and has undergone a couple of significant hardware revisions. The serial number on the bottom of the unit will reveal the HW revision. Some features will be available for later models only.

- **TM1000A serial numbers that start with a number or the letter 'A' use versions 1.XX of the firmware. Units that start with a number only, use the Navman GPS module. Units that start with the letter 'A' were updated to the Global Top GPS module when the Navman module became obsolete.**
- **TM1000A serial numbers that start with the letter 'B' use version 2.X and greater version of the firmware. The major change in this version was that a newer processor is used that supports a greater code space and opportunities for feature increases.**
- **Failure to observe this will cause a failure in the programming and require the unit to be returned to CSS for firmware update**

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## 2 Installation

### 2.1 Location

To receive GPS signals the Time Server's antenna must be located in a location where it can “see” the sky. The GPS module itself is highly sensitive and able to “see” the GPS satellite signals from within many structures. Multi-Story or metal structures may block the GPS signals such that the antenna must be located elsewhere. In these cases, the GPS antenna may be located in a window. The Time Server box can be located anywhere on the network. All that is required is power and a wired network connection. In the worst case, an outdoor antenna may be required.

### 2.2 Connections



#### 2.2.1 Antenna

The GPS antenna is connected through the circular female SMA connector on the rear of the Time Server. By default, the GPS antenna connection provides 3.3V to power the LNA in the GPS antenna. This is correct for the supplied GPS patch antenna with the magnetic base. This voltage can be changed with a jumper on the inside of the Time Server. The Time Server has to be opened up and a jumper moved.

#### Jumper J2

A: 5.0V      B: 3.3V (default)

#### Jumper J8

A: Reset to Factory      B: Normal Operation

The only time this jumper would be changed would be to allow use of a different antenna that requires +5V for the LNA in the antenna. This might be the case for an outdoor installation.

#### 2.2.2 Power

A +5V power supply is supplied with the unit. Connect one end to a standard United States 110-120V outlet and the barrel connector to the rear of the Time Server. The time server will begin trying to find the GPS satellites. On power-up, synchronization to the GPS satellites will take several minutes. No battery backup of position is provided to allow for a warm start so the Time Server is always starting from scratch in determining its location to achieve GPS lock.

#### 2.2.3 Network

Connect the 10/100 RJ45 port on the back of the Time Server to a network connection. Verify that the network settings are correct for your system. See the configuration section of this manual for more information on doing this.

#### 2.2.4 Front Panel Indications

The front panel of the Time Server is very basic in its appearance. Three LEDs show the current status of the unit. The POW indicator indicates that the unit is receiving power through its wall power supply. The LOCK indication indicates that the GPS has located at least three satellites. The SEC LED will blink each second showing that the GPS module is now synchronized to the GPS time signals.

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## 3 Configuration

### 3.1 Web Page – Default password is 'tmachine'

### 3.2 Default IP address is 192.168.1.15

All Time Server parameters are accessed on the configuration web page. The page can be accessed by pointing any web browser at the IP address of the Time Server. The initial IP address is 192.168.1.15 from the factory. It can also be found by connecting a straight RS-232C serial cable to the back of the Time Server and a computer running a terminal program at 115200,N81. In the example below, the IP address has been changed to 10.10.0.96.

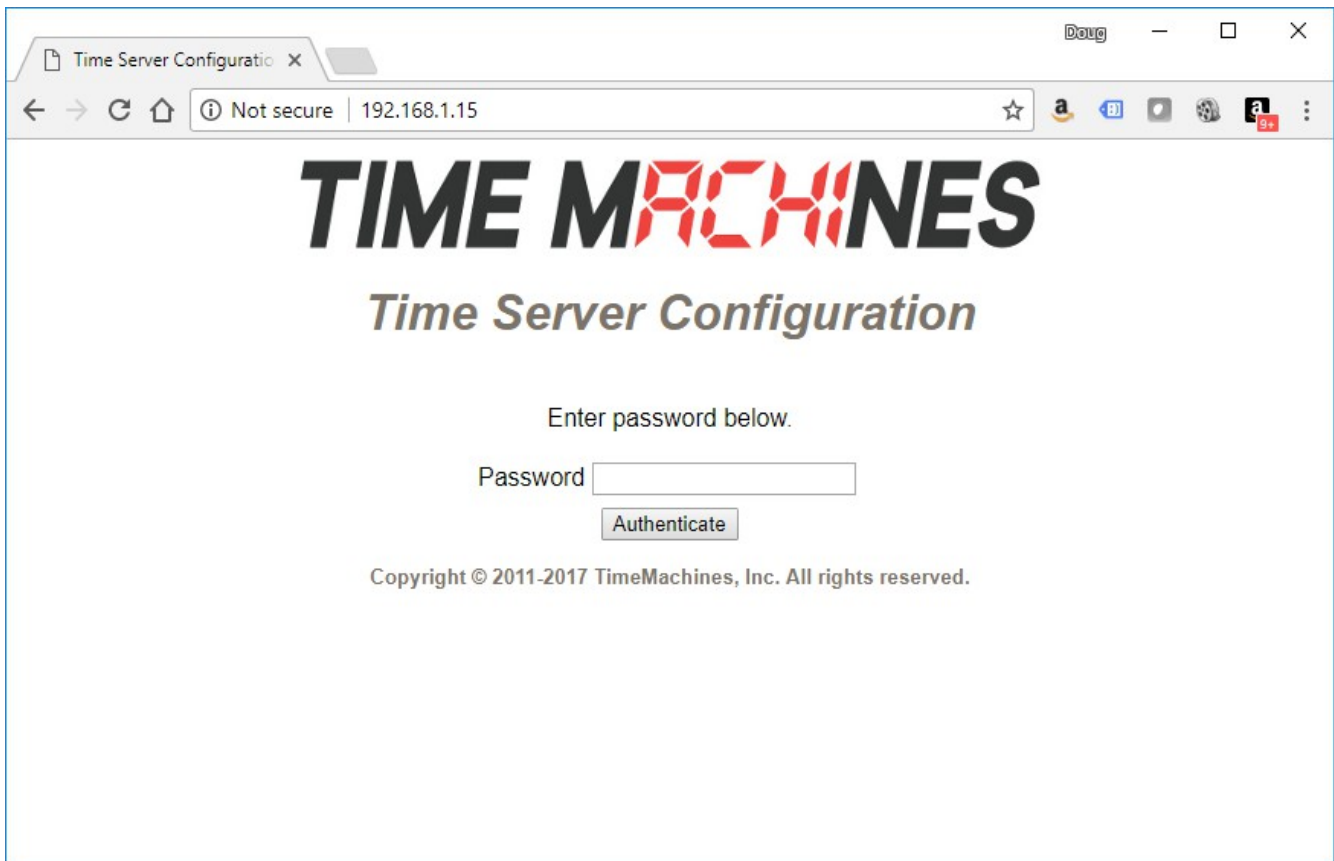
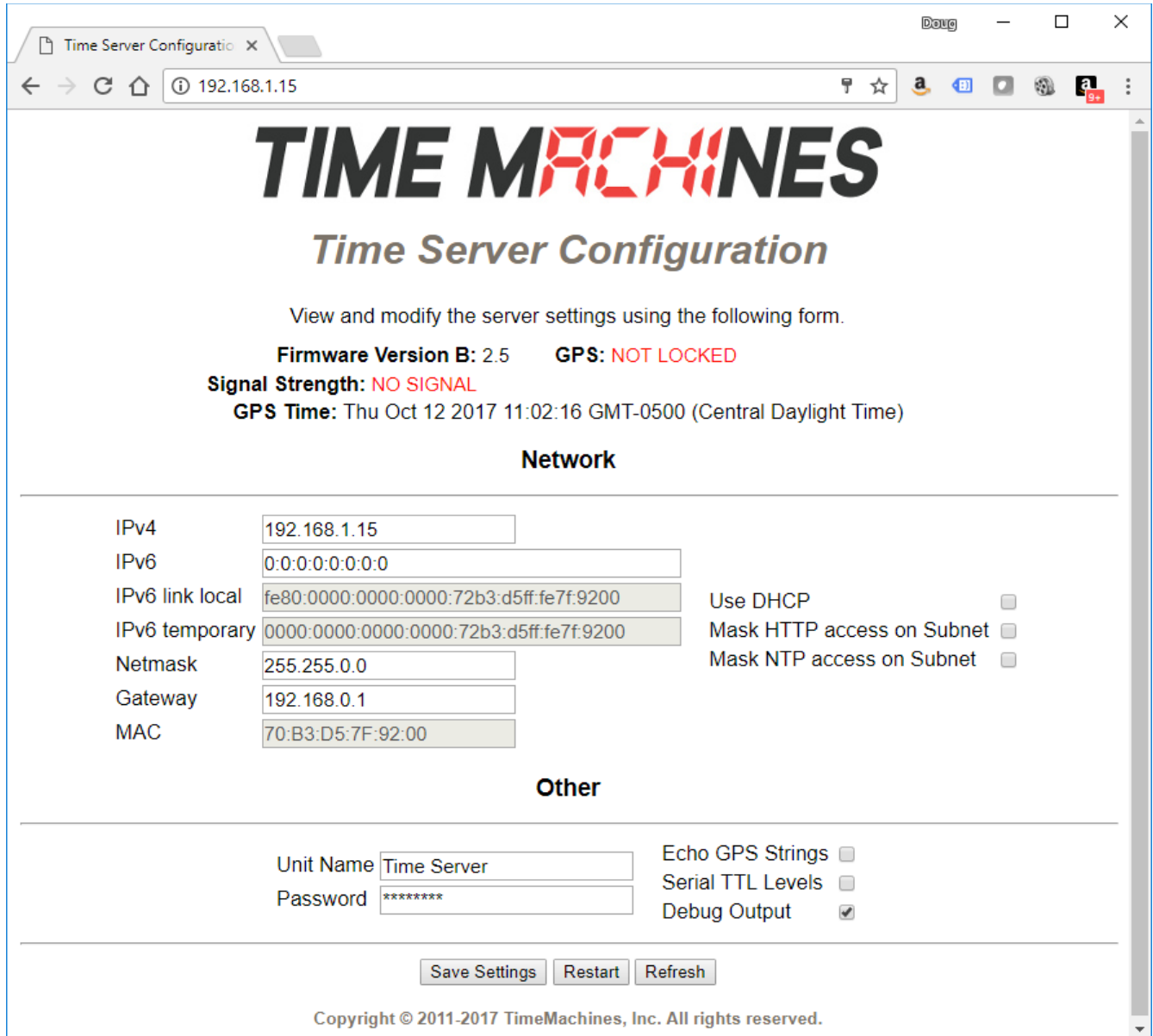


Illustration 1: Password Page



**TIME MACHINES**  
*Time Server Configuration*

View and modify the server settings using the following form.

**Firmware Version B:** 2.5    **GPS:** NOT LOCKED  
**Signal Strength:** NO SIGNAL  
**GPS Time:** Thu Oct 12 2017 11:02:16 GMT-0500 (Central Daylight Time)

### Network

IPv4	<input type="text" value="192.168.1.15"/>	
IPv6	<input type="text" value="0:0:0:0:0:0:0"/>	
IPv6 link local	<input type="text" value="fe80:0000:0000:0000:72b3:d5ff:fe7f:9200"/>	Use DHCP <input type="checkbox"/>
IPv6 temporary	<input type="text" value="0000:0000:0000:0000:72b3:d5ff:fe7f:9200"/>	Mask HTTP access on Subnet <input type="checkbox"/>
Netmask	<input type="text" value="255.255.0.0"/>	Mask NTP access on Subnet <input type="checkbox"/>
Gateway	<input type="text" value="192.168.0.1"/>	
MAC	<input type="text" value="70:B3:D5:7F:92:00"/>	

### Other

Unit Name	<input type="text" value="Time Server"/>	Echo GPS Strings <input type="checkbox"/>
Password	<input type="password" value="*****"/>	Serial TTL Levels <input type="checkbox"/>
		Debug Output <input checked="" type="checkbox"/>

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Illustration 2: Parameters Page

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## **3.2.1 Network Setup**

By default the network parameters are setup to static address 192.168.1.15. The Time Server is able to use DHCP, but the rest of the network will need to be able to automatically adjust to its IP address should it change. This would involve setup with DHCP and DNS systems. Usually, static setup is recommended. Addresses in the Network section must be entered in IPv4, dotted quad, format.

**All of these parameters require a restart to take effect.**

## **3.2.2 GPS Lock, Signal, and Current Time Information**

At the top of the Time Server Configuration page is status information about the software version in the Time Server and from the GPS module in the Time Server. The Firmware Version is displayed and should be known before calling Time Machines for support. The “GPS:” label will state whether the GPS is locked to satellite signals or not. A “LOCKED” status in green letters is required for operation. The “Signal Strength” line will give the signal strength of the top three satellites being received. The possible range is from 0 to 99dB SNR. The TM1000A will use as many satellites as it can receive for the greatest possible accuracy. The current time is also displayed at the top of the web page starting in version 2.2. The time zone is determined automatically from the browser settings. The time is updated when the page is loaded (and GPS is locked) and thereafter is dependent on the system clock of the web browser. Over time this value will drift based on the characteristics of the HW clock in the browser hardware. Refreshing the page will update the time.

## **3.2.3 Use DHCP**

Checking this option will tell the Time Server to ignore the other IP address settings and request an IP address from the network's DHCP server at startup.

## **3.2.4 IPv4 Address**

If the DHCP option is not being used, then the IP address of the unit set to by entering a standard IPv4 dotted quad in this field. 192.168.1.15 or 10.10.0.96 are examples of acceptable formats for this field.

## **3.2.5 IPv6 Address**

This is the 128 bit IPv6 address of the device either statically entered or determined by DHCP. The first 64 bits indicate the network address and the last 64 bits are user defined for their network. Please note that a user should still setup the device as initially using IPv4. They can then set an IPv6 address and/or view the IPv6 temporary. The web page can be accessed using an IPv4 and/or IPv6. The TM1000 will respond to Ping, Ping6, rdate and rdate -6.

## **3.2.6 IPv6 Link Local**

This address is only valid for communications within the network segment (link) and is required for stateless address auto-configuration. Neighbor Discovery Protocol is part of the IPv6 protocol and uses stateless address auto-configuration. This address begins with prefix fe80::/64. The last 64-bits are based on the MAC address of the TM1000. This address is unique to each TM1000 and not modifiable.

## **3.2.7 IPv6 Temporary**

This is a default address based on the network address and the MAC address. The TM1000 uses



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Neighbor Discovery Protocol to find the network address. The last 64-bits are based on the TM1000's MAC address. This address is unique to each TM1000 and not modifiable. The TM1000 will default to this address to serve time if the IPv6 address has not been set, otherwise the modifiable IPv6 address is used to serve time.

## **3.2.8 Mask HTTP access on Subnet**

This checkbox will enable HTTP (web browser) access only on the timeservers configured subnet. This has the effect that the TM1000A will only respond to requests for the web page if they come from the same subnet as the TM1000A is configured on. This is a security feature to limit the access to the configuration of the device only to the local subnet.

## **3.2.9 Mask NTP access on Subnet**

This checkbox will enable NTP access only on the timeservers configured subnet. This allows the time server to ignore requests for time from all devices that are not on the same subnet and provides a measure of security and protection from denial of service attacks.

## **3.2.10 Netmask**

The Netmask entry determines what addresses are on the local network and what addresses are reached through the Gateway. Typical Netmasks are 255.255.0.0 or 255.255.255.0. Consult the network administrator for more information on who this entry should be set.

## **3.2.11 Gateway**

The Gateway IP address is used when a destination address is determined to not be on the local network. Consult the network administrator for this setting.

## **3.2.12 MAC**

This is an information only field and displays the MAC address of the Time Server.

## **3.2.13 Echo GPS Strings Checkbox**

Checking this option will tell the unit to copy all received data from the GPS module's serial port to the serial port on the back of the Time Server. The copied strings are the standard NMEA GPS data strings.

## **3.2.14 Serial TTL Level Outputs Checkbox**

Checking this option will enable the TTL level outputs of the serial port. These are found on Pins 7, 8, and 1. To receive the actual NMEA strings, the "Echo GPS Strings Checkbox" must be checked. Pin 7 is the data from the GPS module, Pin 8 is data that will be sent to the GPS module through the RS-232C port echo'd at TTL level. The data pins are duplicates of the RS-232C data found on Pins 2 and 3, but are provided before conversion to RS-232C levels. Pin 1 is the 1 PPS output. The 1 PPS output is a very narrow signal on the order of 1 uS in width, active high.

## **3.2.15 Debug Output Checkbox**

The debug output checkbox will tell the unit to output debug and operational information to the serial port.



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## **3.2.16 Unit Name**

This can be any alpha numeric name up to 20 characters long.

## **3.2.17 Password**

The password field displays the current password. To change it, enter a new password, push Save and then Reboot for it to take effect. Time Server passwords are limited to 12 characters. The default password is “**tmachine**”

## 4 Troubleshooting

### 4.1 GPS Lock

Getting GPS lock on the Time Server is required for it to function. Most GPS lock issues come down to issues with Antenna location, or cabling. If there are problems getting GPS lock (I.e.the Lock LED doesn't turn on and the 1 PPS LED doesn't flash each second) trying moving the antenna outside and see if that resolves the issue. If it does, try a window and see if lock is maintained. If that works, move the antenna back to its original location and see if lock is lost. This will help determine where lock can be received and where it cannot. If no lock is achieved outdoors, then something is either wrong with the cabling or the Time Server itself. Contact Time Machines for help.

### 4.2 Finding the IP Address

If the IP address of the Time Server is forgotten, there are a few ways to go about finding its IP address. The first is to use a serial terminal program such as Hyper-Terminal or something similar. Set the communications parameters of the terminal program to 115200,N81. Connect a straight through cable between the computer and the Time Server and cycle power on the Time Server. The IP address is printed during startup.

If the Time Server is using DHCP, then it is possible to look up the units IP address on the DHCP server by looking at the list of leases. Look for a MAC address in the lease list that starts with 00:50:C2. This will likely be unique in the DHCP lease list. The IP address associated with this MAC address should be tried.

The third possible way to determine the IP address is to simply check several of the devices using the Time Server on the network to see how they are programmed. If they have a specific IP address programmed into them for time keeping, then that may be the Time Server's base IP address. If a domain name has been assigned to the Time Server, doing a command like “ping timeserver.your-company.com” might show the time servers address as well.

### 4.3 Resetting to Factory Defaults

#### Jumper J8

**A: Reset to Factory B: Normal Operation**

Jumper J8 on the inside of the TM1000A is used to reset the units software settings to factory original. This is useful when a password is forgotten or the IP address cannot be determined. To do this, remove the 4 screws from the front panel. With some care, the jumper can be reached from the front of the unit without removing the PCB. Move J8 to the “A” position and apply power. After a few seconds, remove the power connection, replace J8 to the “B” position and reassemble the unit. It should now have the factory default password and IP address information.

## 5 Specifications

### 5.1 Time Server Features and Specifications

- Receive time information from GPS satellites anywhere on the surface of the earth
- RFC1119/1305 NTP Protocol to serve time (Network Time Protocol)
- RFC1769/2030/4330 SNTP Protocol (Simple Network Time Protocol)
- Server Time Level: Stratum 1
- Server Time Precision: better than 5mS + network jitter.
- All networked computing platforms support time synchronization either natively or with add on drivers including: Windows, Macintosh, and Linux. Many other devices can access the device as well including VoIP phones and digital clocks.
- 10M/100M adaptive network interface
- Unit is capable of serving 135+ synchronizations per second. That provides support for over 120,000+ devices updating every 15 minutes on the network.
- Active Patch GPS antenna included. Magnetic base.
- Compliant with FCC Part 15, class B for radiated emissions and is a lead free product.
- Power Requirements: less than 4 Watts continuous.
- Environmental Requirements: Commercial temperature range, 0-70C, 95% humidity non-condensing. Altitude -304m to 18,000m.
- Networking: Static or DHCP IPv4 addressing. Standard browser interface for setup.
- Serial port supports both RS-232C levels and TTL (+3.3V) outputting standard NMEA information strings, as well as the 1PPS signal at TTL levels. TTL signals can be turned off via software control.
- Indications: Power, GPS Signal Lock, and 1PPS indications
- Rear Connections: Power, Cat5 Ethernet, Serial, and GPS antenna via SMA connection. Supports +3.3V and 5V active GPS antennas with internal jumper setting.
- Mechanical Dimensions: 5 in. x 4.2 in. x 1.3in.

### 5.2 GPS Module Specifications

- Based on SiRF GSC3e Lpx chipset.
- 20 channel low power receiver module
- Sensitivity: -144dBm, C/N0=26dBHz
- GPS Time Precision: <1us, typical +/- 300ns ref UTC.
- Antenna Connection: 1575.42MHz (L1 Band) at a level between -135dBm and -159dBm into

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50 Ohm impedance. Maximum input return loss is -9dB.

- TTF (Time To First Fix)
- Cold start @-125dBm typically 33 seconds
- Re-acquisition (<10s obstruction) typically 1 second

## **5.3 Antenna Specifications**

- Active patch antenna with magnetic base.
- Size: 1.57 in. x 1.89 in. x 0.51 in thick, 43 grams.
- Amplifier: LNA +20dB Noise: 1.5dB VSWR: 2.0 Voltage: 2.7-6.0V.
- Cable: RG174, 5m length, SMA male.
- Environmental: -40 to +85C
- Waterproof to IPx6

(Specifications are subject to change without notice)