

ULTRALINK

Linking computers to the real world

*WWVB Based UTC Clock With Signal
Strength Meter and RS232 Interface*

DESCRIPTION

General

The Model 333FS provides UTC time (universal coordinated time) and date information based on the United States Atomic Clock Standard as broadcast by WWVB operated by the National Institute of Standards and Technology (NIST).

All WWVB broadcast information including the date, time, flags and signal strength are available on the unit's display and via an RS232 interface. WWVB signal strength is also indicated on an analog meter.

Functional

The unit consists of two elements: the antenna/receiver and the decoder.

The antenna incorporates a high quality ferrite loopstick which is factory tuned for maximum sensitivity and selectivity.

The receiver uses baseband amplification with crystal bandpass filtering. This is followed by a demodulator which provides a digital output corresponding to received signal data.

The display unit uses a microprocessor to decode WWVB time code signals using synchronous bit detection. This processor also correlates received WWVB information to provide accurate time used to set the onboard real-time clock (RTC).

The RTC counters are driven by a precision quartz reference for continuous accurate timekeeping.

Time, date and receive status information is available on a 2 X 16 line alphanumeric display.

The RS232 interface provides communication of time, date and flags to external computing devices.

An A/D converter is used to digitize receiver AGC signal for indication of WWVB signal strength.

Power circuitry provides internal operating voltages and maintenance of onboard rechargeable standby batteries.

Physical

Both units are contained in polystyrene enclosures. The receiver can be located for maximum reception and the decoder display unit may be located for convenient viewing. Receiver, RS232 and power inputs are by rear panel connectors.



FEATURES

- Backlight LCD display
- Analog field strength meter
- Display of all received WWVB information including leap year, leap second, daylight savings and UTC correction flags
- Internal clock for loss of signal periods
- 0.01 second accuracy
- RS232 interface with ASCII formatted data
- 1 pulse per second BNC and DCE output
- AC powered using wall mounted transformer
- Battery backed-up RTC with onboard recharger

APPLICATIONS

- Accurate UTC clock
- Computer time synchronization
- Facilities time standard
- Laboratory clock
- WWVB field strength monitoring
- WWVB transmitted code monitoring

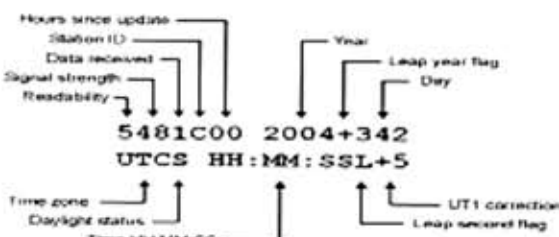
OPERATION

Front Panel

Displays are located on the Model 333FS front panel as shown below:



Display - A two line by 16 character display shows date, time, flag and receive status information. Information format follows:



Readability - Running average of signal readability from 1 to 5 (1 is unreadable, 5 is 100% readability).

Signal strength - Indicates peak signal strength in dB with 0 dB = 2×10^{-7} V/meter. Max signal strength is 99 (1.78×10^{-7} V/meter. Refer to M333FS Digital Signal Strength Calibration Chart for details.

Data received - Indicates value of last second's data bit = 0, 1, 2 (mark) or 3 (unknown).

Station ID - Indicates reception from Colorado or Hawaii.

Hours since update - Indicates time since last WWVB time and flag code update.

Signal "locked" status - Darkened box indicated the receiver is currently phase locked to WWVB.

Year - Indicates received year corrected to reflect proper century - valid from 2000 to 2099.

Leap year flag - Blank if not leap year, + if leap year.

Day - Shows number of the current day in the year.

Time zone - Indicates date/time display time is UTC.

Daylight status - Indicates winter/summer time as follows:

| | |
|----------|---|
| S | Indicates standard time (STD). |
| O | Transition into DST from STD. Set at 0000Z on first DST day and changed to a D 24 hours later. |
| D | Indicates daylight savings time (DST). |
| I | Transition into STD from DST. Set at 0000Z on first STD day and changed to S 24 hours later. |

Time - Current time in hours, minutes, seconds.

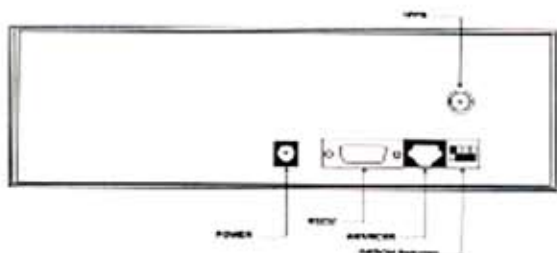
Leap second flag - Changes from (sp) to +/- during month preceding leap second adjustment.

UT1 correction - UT1 adjustment (+/- .1 second increments).

Power - AC power is indicated by screen illumination.

Rear Panel

Connection of power and various signals is made on the rear panel of the Model 333FS. Rear panel components and their function is shown below:



Power - 2.5mm dia jack mates with power cord on Ultralink supplied wall mounted power supply.

RS232 - 9 pin female "D" connector (DB9F) mates with RS232 cable to host computer using either DB9M or DB25F at host end. RS232 pin assignments are as follows:

| Pin | Signal |
|-----|-------------|
| 1 | 1 PPS (DCE) |
| 2 | TXD (out) |
| 3 | RXD (In) |
| 5 | GND |
| 7 | RTS |

Option switches - 4 position dip switch provides installed option selection as follows:

- 1 Battery backup - on is enabled
- 2 Report time each second - ON is enabled
- 3-4 Reserved.

ANT/RCVR - RJ11 6/4 jack mates with 4-wire modular cable to connect to Ultralink antenna/receiver assembly. This cable is supplied with the antenna/receiver assembly. RJ11 connector pinouts are as follows:

| Pin | Signal |
|-----|----------|
| 1 | Reserved |
| 2 | VCC |
| 3 | TCO |
| 4 | AGC |
| 5 | GND |
| 6 | Reserved |

Pin 1 is at the left with the locking tab facing down.

1 PPS - BNC female connector.

OPERATION

Power Up

AC power is indicated by screen illumination.

Backup Battery Enable

Upon power up, place Option Switch 1 in the ON position to enable RTC battery backup. During shipment and periods of no use, set this switch to OFF to avoid battery cell reversal.

Time Synchronization

Immediately after start up. Immediately after power up, the display will start counting seconds, rolling over to minutes as the time correlation process continues. Flag fields will be blank or "?".

Once verified, the time will appear on the display and the time delimiters will change to colons (:).

Time validation may take from a few minutes to hours depending on reception conditions. Once time and flags have been validated, time re-synchronization and flag validation is continuous.

RS232 Interface

Commands are by a single ASCII character sent to the unit. A carriage return is not required after each command. Invalid characters are ignored.

Time data is read by sending a "T". Alternately time is reported every second if the RS232 auto report mode is selected (see Option Switches).

RS232 data is a 34 byte string beginning with (cr)(lf) followed by an ASCII string exactly as shown on display. The sequence is as follows:

(cr)(lf)5481C00n2004+342UTCS HH:MM:SSL+5

The first character (cr) is the time "MARK" and is output within one millisecond of the time returned. The n character (Hex A5) is active if the unit is locked to WWVB, otherwise it is a space.

Sending an "I" returns the 10 byte ID string:

(cr)(lf)ULM334.E

Power for the RS232 circuitry is derived from the RTS signal line. The host RS232 communication program should allow a 10 millisecond delay after making the RTS signal active before initiating RS232 communication.

Reset

The decoder may be reset by removing power and setting Option Switch 1 to OFF for a few seconds.

INSTALLATION

Receiver

The receiver unit is designed to be used indoors in a wood frame structure. Operation inside metal buildings or buildings with metal reinforcements may be marginal. Locate the receiver in a good reception area such as near a window or in an attic.

The receiver should be mounted with the long side horizontal. It may be mounted flat (table/shelf) or vertical (wall mounted). The antenna/receiver is directional. Best reception is obtained with the long side perpendicular to Fort Collins, Colorado.

Avoid locating near suspected interference sources such as:

| | |
|---------------------|-----------------------------|
| Lamp dimmers | Fluorescent lamps |
| Electronic igniters | CRT monitors |
| Battery chargers | Switching power supplies |
| Motors | Automobile ignition systems |
| Power lines | Nearby radio transmitters |

Note: Interference is diminished by the square of the distance (i.e., doubling the distance from the source will reduce its effect by 4).

Orient the antenna/receiver for maximum signal strength. If the signal level is less than S8 move the antenna to a location where it improves. Additionally the antenna should be oriented for maximum signal readability. With readability of less than 3 time code data is not reliable enough to decode time information.

After final orientation secure receiver to prevent inadvertent movement (double sticky tape is OK).

Decoder/Display

Connect the receiver to the decoder/display unit using the modular cable supplied. This connection should be made before connecting the unit to power or enabling battery backup.

If longer modular cable length is required to move the receiver away from noise sources, use a modular cable with pin 1 to pin 1 connections (normal telephone modular cables are reversed) or use a telephone extension cable (normally wired with 1 to 1 connection) available from local sources.

Connection to the power supply is by the 2.5 mm power jack. A mating plug is on the cord attached to the wall mounted power supply furnished. Install power supply in a 120 VAC outlet before connecting to the unit.

Computer connection is by the DB9 connector. This cable may be up to 25' in length. A null modem cable is not required when connecting to a PC.

SPECIFICATIONS

Operational

Receiver

| | |
|-----------------------|--|
| Transmitter received | WWVB |
| Receive frequency | 60 kHz |
| Transmitter location | Ft. Collins, Colorado USA |
| Modulation type | 10 dB carrier reduction |
| Receive bandwidth | 7Hz @ 3dB points |
| S/N @ 50uV/meter (S9) | 14 dB average daylight background |
| Reception | Est >23 hours/day @ 50 uV/meter signal strength with background noise only (electrically noise free environment) |

Decoder

| | |
|-------------------------|---|
| Time acquisition | Approximately 4 minutes for complete time and flag validation under noise free signal reception conditions |
| Clock absolute accuracy | +/- 0.015 sec upon reception. 0.015 sec/hour drift during loss of signal periods |
| Clock repeatability | +/- 2 milliseconds when "Lk" indicated |
| Display | 2 X 16 LCD alphanumeric character display with LED backlight |
| Field strength meter | Indicated in "S" units (approximately 5 dB/S unit), S9 is 50 uV/meter |
| Field strength data | Indicated dB from 0 to 99 from 0 dB - 2×10^{-7} volts/meter 99dB - 1.78×10^{-2} volts/meter S9 (5×10^{-6})volts/meter = 48 |
| Daterange | Indicates correct year from 2000 to 2099 |
| RS232 baudrate | 9600 |
| RS232 protocol | 8,1,N |
| Receiver enable | Continuous |
| 1 PPS signal | 50% duty cycle TTL. Low to high transition indicates beginning of second |

Physical

| | |
|------------------------|---|
| Receiver/decoder cable | RJ11-4/6 wired pin 1 to pin 1 - 300 feet maximum length |
| Data cable | DB9M - 25 feet maximum length |
| Size | |
| Antenna/receiver | 5.2" L X 2.6" W X 1" H |
| Decoder | 8" W X 2.5" H X 7" D |
| Weight | 1.5 Lb |
| Construction | Polystyrene enclosures for both units |

Electrical

| | |
|--------------|---|
| Power | 120 VAC @ .04A primary converted to 5 V DC @ 300 mA with UL approved plug mounted power supply |
| Backup power | 3.6V NiCad rechargeable with 24 hour backup for RTC and field strength metering. Display is not operational while running on backup power |

ORDERING INFORMATION

Order Model 333FS. Includes:

Receiver with antenna
Decoder with display and meter
14' modular connecting cable
Wall mounted power supply
6' DB9M/F RS232 cable

For operation with computer having DB25 serial port requires DB9M/DB25F adapter.

Made in the USA.

ULTRA LINK

Phone 775 782 9758

Fax 775 782 0345

Email info@ulio.com

Website www.ulio.com

Mail PO Box 1809, Minden, NV 89423

Ship 1547 Anthony Ct, Gardnerville NV 89410

M333FS Digital Signal Strength Calibration

| FS | V/M | dBuV | Read | S Meter |
|------------|-----|------|------|---------|
| 1.9953E-07 | | -14 | 1 | |
| 2.2387E-07 | | -13 | 2 | S1 |
| 2.5119E-07 | | -12 | 3 | |
| 2.8184E-07 | | -11 | 4 | |
| 3.1623E-07 | | -10 | 5 | |
| 3.5481E-07 | | -9 | 6 | |
| 3.9811E-07 | | -8 | 7 | |
| 4.4668E-07 | | -7 | 8 | S2 |
| 5.0119E-07 | | -6 | 9 | |
| 5.6234E-07 | | -5 | 10 | |
| 6.3096E-07 | | -4 | 11 | |
| 7.0795E-07 | | -3 | 12 | |
| 7.9433E-07 | | -2 | 13 | |
| 8.9125E-07 | | -1 | 14 | S3 |
| 0.000001 | | 0 | 15 | |
| 1.122E-06 | | 1 | 16 | |
| 1.2589E-06 | | 2 | 17 | |
| 1.4125E-06 | | 3 | 18 | |
| 1.5849E-06 | | 4 | 19 | |
| 1.7783E-06 | | 5 | 20 | S4 |
| 1.9953E-06 | | 6 | 21 | |
| 2.2387E-06 | | 7 | 22 | |
| 2.5119E-06 | | 8 | 23 | |
| 2.8184E-06 | | 9 | 24 | |
| 3.1623E-06 | | 10 | 25 | |
| 3.5481E-06 | | 11 | 26 | S5 |
| 3.9811E-06 | | 12 | 27 | |
| 4.4668E-06 | | 13 | 28 | |
| 5.0119E-06 | | 14 | 29 | |
| 5.6234E-06 | | 15 | 30 | |
| 6.3096E-06 | | 16 | 31 | |
| 7.0795E-06 | | 17 | 32 | S6 |
| 7.9433E-06 | | 18 | 33 | |
| 8.9125E-06 | | 19 | 34 | |
| 0.00001 | | 20 | 35 | |
| 1.122E-05 | | 21 | 36 | |
| 1.2589E-05 | | 22 | 37 | |
| 1.4125E-05 | | 23 | 38 | S7 |
| 1.5849E-05 | | 24 | 39 | |
| 1.7783E-05 | | 25 | 40 | |
| 1.9953E-05 | | 26 | 41 | |
| 2.2387E-05 | | 27 | 42 | |
| 2.5119E-05 | | 28 | 43 | |
| 2.8184E-05 | | 29 | 44 | S8 |
| 3.1623E-05 | | 30 | 45 | |
| 3.5481E-05 | | 31 | 46 | |
| 3.9811E-05 | | 32 | 47 | |
| 4.4668E-05 | | 33 | 48 | |
| 5.0119E-05 | | 34 | 49 | |
| 5.6234E-05 | | 35 | 50 | S9 |

| FS | V/M | dBuV | Read | S Meter |
|------------|-----|------|------|---------|
| 6.3096E-05 | | 36 | 51 | |
| 7.0795E-05 | | 37 | 52 | |
| 7.9433E-05 | | 38 | 53 | |
| 8.9125E-05 | | 39 | 54 | |
| 0.0001 | | 40 | 55 | |
| 0.0001122 | | 41 | 56 | |
| 0.00012589 | | 42 | 57 | |
| 0.00014125 | | 43 | 58 | |
| 0.00015849 | | 44 | 59 | |
| 0.00017783 | | 45 | 60 | +10dB |
| 0.00019953 | | 46 | 61 | |
| 0.00022387 | | 47 | 62 | |
| 0.00025119 | | 48 | 63 | |
| 0.00028184 | | 49 | 64 | |
| 0.00031623 | | 50 | 65 | |
| 0.00035481 | | 51 | 66 | |
| 0.00039811 | | 52 | 67 | |
| 0.00044668 | | 53 | 68 | |
| 0.00050119 | | 54 | 69 | |
| 0.00056234 | | 55 | 70 | +20dB |
| 0.00063096 | | 56 | 71 | |
| 0.00070795 | | 57 | 72 | |
| 0.00079433 | | 58 | 73 | |
| 0.00089125 | | 59 | 74 | |
| 0.001 | | 60 | 75 | |
| 0.00112202 | | 61 | 76 | |
| 0.00125893 | | 62 | 77 | |
| 0.00141254 | | 63 | 78 | |
| 0.00158489 | | 64 | 79 | |
| 0.00177828 | | 65 | 80 | +30dB |
| 0.00199526 | | 66 | 81 | |
| 0.00223872 | | 67 | 82 | |
| 0.00251189 | | 68 | 83 | |
| 0.00281838 | | 69 | 84 | |
| 0.00316228 | | 70 | 85 | |
| 0.00354813 | | 71 | 86 | |
| 0.00398107 | | 72 | 87 | |
| 0.00446684 | | 73 | 88 | |
| 0.00501187 | | 74 | 89 | |
| 0.00562341 | | 75 | 90 | +40dB |
| 0.00630957 | | 76 | 91 | |
| 0.00707946 | | 77 | 92 | |
| 0.00794328 | | 78 | 93 | |
| 0.00891251 | | 79 | 94 | |
| 0.01 | | 80 | 95 | |
| 0.01122018 | | 81 | 96 | |
| 0.01258925 | | 82 | 97 | |
| 0.01412538 | | 83 | 98 | |
| 0.01584893 | | 84 | 99 | |