ULTRALINK

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WWVB Receiver/Decoder Module With Serial BCD Interface

DESCRIPTION

General

The Model 321BS provides a computer readable UTC time (universal coordinated time) and date information based on the United States Atomic Clock Standard.

The system receives and decodes signals broadcast by Radio Station WWVB which is operated by NIST (National Institute of Standards and Technology).

Computer interface is via a two wire serial communication link.

The system is designed for embedded applications where accurate time is essential to system operation and data integrity.

Functional

The unit consists of two functional elements - the WWVB receiver and decoder.

The receiver module uses a loopstick antenna to receive WWVB signals. A single chip receiver amplifies and demodulates the WWVB signal for subsequent processing.

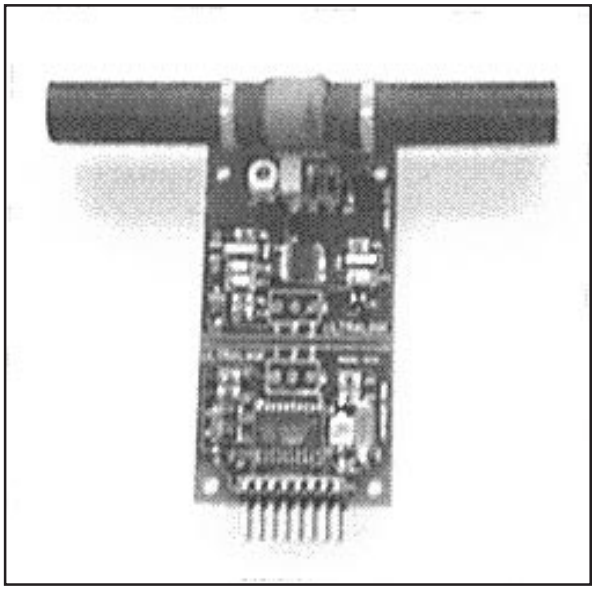
The decoder module contains a microprocessor which digitally processes WWVB time code signals, maintains an internal real time clock and supervises the serial interface. A quartz reference is used for continuous timekeeping.

Physical

The unit is constructed on two printed circuit boards. The receiver board has an attached loopstick antenna. This board should be mounted in a position to receive signals - see installation.

The decoder unit is a small footprint board which may be mounted with host electronics.

Screw terminal connectors allow receiver/decoder to be connected by a three a three wire cable.



FEATURES

- ❑ BCD communication protocol
- ❑ Efficient time message protocol
- ❑ 200 Hz and 1 pulse per second outputs
- ❑ Leap year, second and daylight savings flags
- ❑ Receiver active status output
- ❑ Year 2000 compatible
- ❑ 0.1 second accuracy
- ❑ Internal clock for loss of signal periods
- ❑ 9600 and 2400 baud
- ❑ Low power
- ❑ Selective receiver with dual crystal filters
- ❑ Sensitive tuned loopstick antenna

APPLICATIONS

- ❑ Clock synchronization
- ❑ Embedded system timekeeping
- ❑ Data acquisition timestamping
- ❑ Precision timers/sequencers
- ❑ Personnel time clocks
- ❑ Entry systems
- ❑ Automatic reporting systems
- ❑ Traffic signal synchronization
- ❑ Telephone system timekeeping
- ❑ Security systems
- ❑ Tamperproof time stamping
- ❑ Cryptography

OPERATION

Commands and Responses

Commands are single bytes sent to the unit. A summary of commands (in hexadecimal) follows:

Hex	ASCII	Command
44	**D**	Date
47	**G**	Force update
49	**I**	Firmware rev
4C	**L**	Last update
52	**R**	Receive data
53	**S**	Receive status
54	**T**	Time
55	**U**	UT1 correction

The commands are sent as single byte. A carriage return is not required. Invalid commands are ignored. A description of commands, and return message format follows:

Notes:

1. The return time "mark" is when the decoder receives the **D** or **T** command.
2. Bits are numbered from bit 0 (LSB) to bit 7 (MSB).

D Returns an 3 byte string as follows:

YY FD DD

YY Years from 0 to 99 BCD

FD Bit 7 indicates century (valid from 1990 to 2089)
0 = 1900
1 = 2000
Bit 6 is set to 1 if leap year in progress
Bit 0,1 indicate days X 100

DD Days from 0 to 99 BCD

G initiates a receive update cycle. Upon reaching a time quality factor of 3 and flag correlation, time reception will be terminated.

I returns firmware information byte with high nibble indicating major release in hex from 0 to F and low nibble indicating revision in hex from 0 to F.

L returns a single byte indicating number of hours since update from 0 to 99 BCD.

R initiates a tuning mode which returns a byte each second with the following information:

Bits 0,1 indicate data decoded at last second and are returned as follows:
00 = Zero
01 = One
10 = Mark
11 = Unknown (bad)

This mode is terminated by reception of any other valid command byte.

S Returns a status byte string as follows:

Bits 6,7 indicate receive status as follows:
00 = inactive
01 = receive
11 = noisy reception

Bit 2 is set to 1 when flags are validated

Bits 0,1 indicate quality of time measured by number of correlating frames received.

T Returns a byte as follows:

HH MM SS

HH Bits 6,7 indicate daylight savings status
00 = Standard time
01 = Transition from STD to DST. Set at 0000Z on first DST day and changed to "11" 24 hours later
11 = DST
10 = Transition from DST to STD. Set at 0000Z on first STD day and changed to "00" 24 hours later
Bits 4,5 indicate UTC hours X 10
Bits 0-3 indicate UTC hours X 1

MM Minutes from 0 to 59 in BCD

SS Seconds from 0 to 59 in BCD

U Returns UT1 time correction byte as follows:

Bit 7 is set to 1 for minus correction
Bit 6 is set to 1 for plus correction
Bit 5 is set to 1 if leap second pending
Bits 0-3 indicate UT1 correction in 100's of milliseconds

OPERATION - continued

Initialization

When powered up, the decoder initiates a reset cycle which lasts 2 seconds. Commands sent during the reset cycle will be ignored.

The decoder may be reset by removing power for approximately 5 seconds.

Upon initialization the unit will automatically initiate the WWVB reception mode. Reception continues until time and flags have been verified.

Immediately after initialization the **T** command will return the following time message:

00 00 00

Reception of the first time frame takes 1 to 2 minutes. Upon reception of the first validated time frame, the **S** command will return a message showing a quality factor of 1.

Time verification is reached with quality factor of 3. While time may be seem accurate on the first frame, allow the quality factor to reach 3 before using time for critical applications.

Flags should not be used until are verified as indicated by flag status bit 2. This will occur after by three consecutive identical readings.

Automatic update mode

After initialization automatic time updates are initiated at each hour UTC and flags are re-verified at 00 hours UTC each day.

Command update mode

Time and flags may be re-verified at any time by issuing the "**G**" command.

Receive data mode

This mode is used to initially set antenna position or for diagnostic purposes.

This mode's normal sequence of operation is for the incoming bit to become randomly active, followed by WWVB synchronization lock. After this data bits are decoded and returned once a second

Power options

When powered continuously (24hour day operation) the onboard RTC may used as the system clock. This mode provides the capability of updating time frequently, allowing the unit to achieve highest accuracy.

To reduce power consumption, intermittent operation may be used to periodically update existing system real-time clocks. For best results, updates should be scheduled during peak reception times (usually just after midnight locally).

INSTALLATION

Host Connection

Mates with an 8 pin female 0.025" square post connector. Host connection serial cable may be up to 25 feet long.

Signals

Host connector signal pin assignment and usage is as follows:

Pin	Signal	Definition
1	**VCC**	+3.5 to 15 volts DC from host
2	**Rxd**	Received data - serial input - TTL level data true going
3	**Txd**	Transmitted data - serial output - TTL level data true going
4	**200Hz**	Negative going TTL pulse output with varying duty cycle - used for diagnostic purposes
5	**1PPS**	TTL level pulse with 1 pulse per second 50% duty cycle. Positive edge indicates start of each second. The signal is output only after reception of the first valid minute is received. The signal is synched to WWVB within 20mSec at each time update. The signal will drift with internal RTC drift and will be re-synchronized at each WWVB reception/RTC update.
6	**RCV**	Receiver active - positive going during reception
7	**BAUD**	Serial communication baud rate control. Open is 9600 baud. Connect this signal line to **GND** for 2400 baud.
8	**GND**	Power and signal ground return signal line

Module Connection

Connect receiver to decoder using a three wire cable with 26 gauge or larger wire. Outside cable runs should be shielded if noisy electrical environments - connect shield to system chassis or enclosure ground. Maximum cable length is 200'.

INSTALLATION - continued

Placement Considerations

The receiver/antenna unit must be in a location compatible with acquisition of radio signals. It will not operate inside a metal enclosure or near wiring or metal objects which shield incoming signals.

The receiver is subject to interference which may be generated by many electrical sources present in embedded systems including:

RF generators	Microprocessors
CRT displays	Switching power supplies
Battery chargers	Stepper/DC motors

Likewise the unit is subject to external interference from sources such as:

- Lamp dimmers
- Fluorescent lamps
- Electronic igniters
- Power lines
- Automobile ignition systems
- Nearby radio transmitters

Provisions should be made to separate noise sources from the antenna/receiver or shield unit from them. Alternately, shut down interfering activities during reception with the **RCV** signal.

Likewise, provisions should be made to alert the operator of equipment in which the receiver is used to avoid use in a location or environment which has such possible interference sources.

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

Other sources of interference include nearby lightning storms, rain or high winds causing static.

Fading is caused by multiple signal paths and is usually encountered during the transition from sunlight to darkness (gray line) along the signal path.

SPECIFICATIONS

Operational

Transmitter received	WWVB
Receive frequency	60 kHz
Transmitter location	Ft. Collins, Colorado USA
Reception availability	20 hours/day @ 100uV/meter signal strength
Time acquisition	2.5 minutes typical during good signal reception periods
Clock accuracy	+/- 0.02 Sec upon synchronization. 0.02 Sec/hr max drift during loss of signal periods.
Date range	Indicates correct year from 1990 to 2089
Baud rate	2400, 9600 Selectable
Protocol	8,1,N
Data format	Packed BCD
Atomic time synch	Upon power up and on every hour thereafter

Physical

Operating temp	+10 to +35 C
Host connector	8 pin 0.1" spaced 0.25 sq post
Module connector	3 wire Euro style terminal block
Size	Receiver 4" W x 2" H x .7" T Decoder 1.5 W 1.15 H x .25 T (see outline drawing)
Weight	0.5 lb
Construction	Printed circuit board

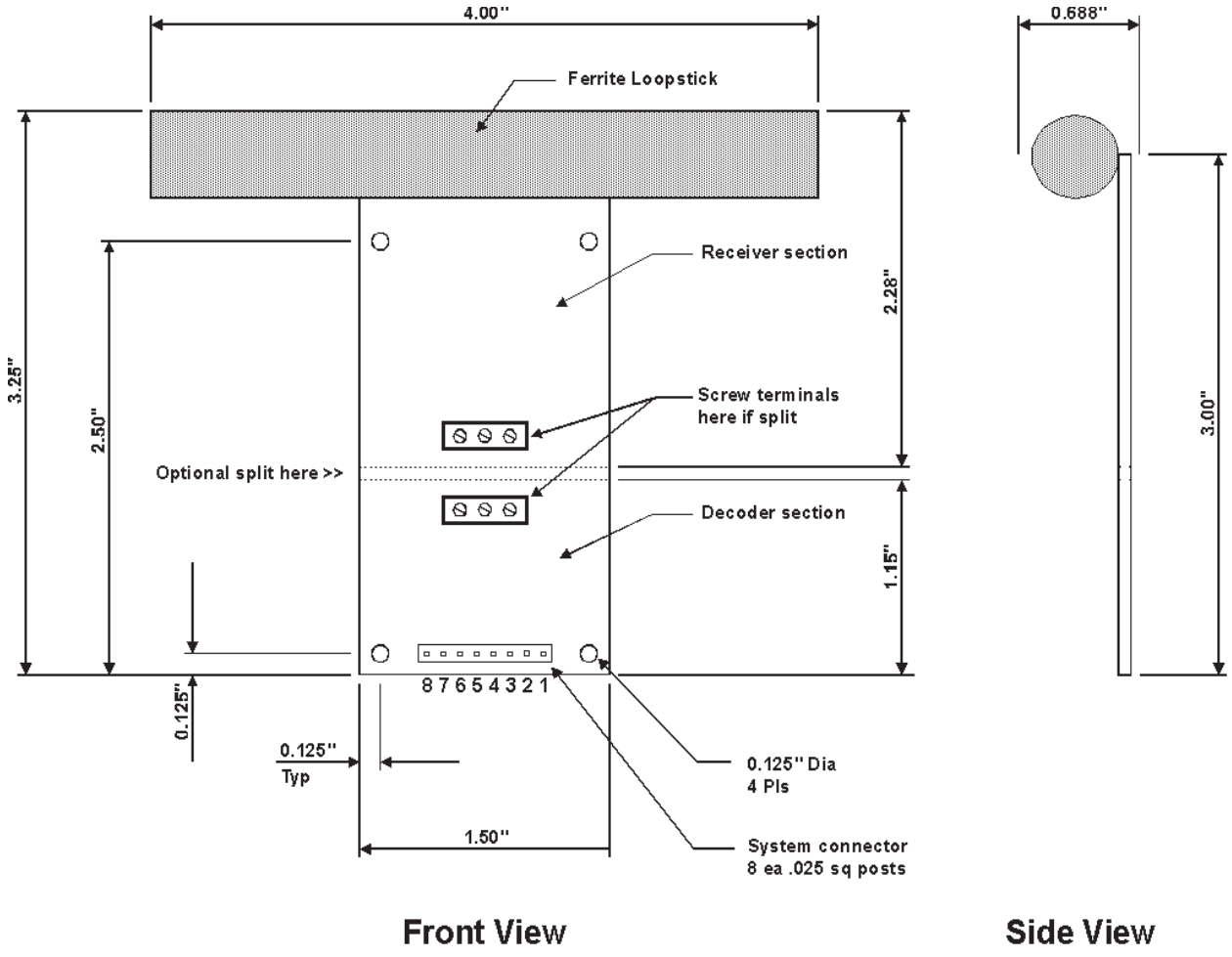
Electrical

Power	+3.5 to 15V @ 600uA

Made in the USA.

SPECIFICATIONS - continued

Mechanical dimensions



ORDERING

For combined unit order Model 321BS.

See Ultralink OEM price list for current pricing.

For special applications, contact factory with requirements.

ULTRALINK

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