ULTRALINK

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WWVB Receiver/Decoder With Serial BCD or ASCII Interface

DESCRIPTION

General

The Model 321BS provides computer readable time and date information based on the United States Atomic Clock Standard. This is obtained from signals broadcast by radio station WWVB which is maintained by the National Institute of Standards and Technology

The Model 321BS is designed for embedded applications where accurate time is essential to system operation and data integrity.

The M321BS provides either packed BCD or ASCII data formats. The packed BCD format provides extremely efficient data transfer while minimizing host processor input buffer memory requirements. The ASCII format reduces host processing requirements when serial ASCII displays are used.

Operational

Host communication is by a two wire asynchronous serial link. Data rate and format have been chosen to provide a maximum of information with minium operating power.

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.

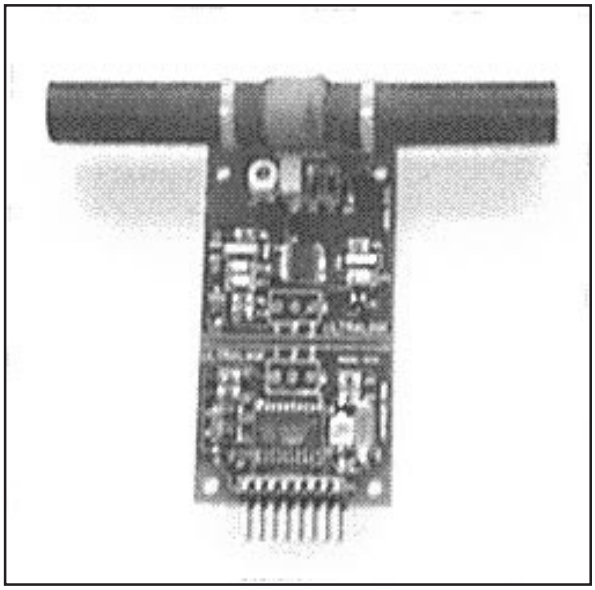
The decoder module contains a microprocessor which digitally processes WWVB time code signals, maintains an internal real time clock and supervises the serial interface. A quartz reference is used for continuous timekeeping.

Physical

The unit is constructed on a printed circuit board with an attached loopstick antenna.

To facilitate installation and mounting options, the board is constructed so it may be split into two sections. In this case the decoder unit may be mounted with host electronics and the receiver unit mounted in a location where WWVB radio signals may be received.

When split, screw terminal connectors allow receiver/decoder to be connected by a three wire cable.



FEATURES

- ❑ BCD or ASCII data formats
- ❑ Year 2000 compatible
- ❑ 0.1 second accuracy
- ❑ 1 PPS, 200 Hz and Receive "active" outputs
- ❑ Leap year, second and daylight savings flags
- ❑ Internal clock for loss of signal periods
- ❑ 2400 or 9600 baud operation
- ❑ Low power
- ❑ Selective receiver with dual crystal filters
- ❑ Sensitive tuned loopstick antenna

APPLICATIONS

- ❑ Embedded system real time clock
- ❑ Data acquisition time stamping
- ❑ Precision timers/sequencers
- ❑ Automatic reporting systems
- ❑ Clock synchronization
- ❑ Tamperproof time stamping
- ❑ Cryptography

OPERATION

Commands and Responses

Commands are single bytes sent to the unit. There are two formats for each command.

When the numerical (HEX) command is used, the return string is in packed BCD (2 nibbles per byte).

With ASCII commands, the return string is ASCII with each character representing a nibble. Numeric values are ASCII BCD. Flag nibbles are ASCII hex.

A summary of commands follows:

HEX	ASCII	Command
01	**A**	Read time
02	**B**	Diagnostic receive
03	**C**	Force update
04	**D**	Read UT1 correction
05	**E**	Read firmware rev

A carriage return is not required. Invalid commands are ignored. A description of command return message formats is shown below.

Command 01 Returns an 8 byte string with nibbles paired:

RX YY LT DD HH MM SS mm

Command A Returns a 16 byte string with each nibble represented by an ASCII character:

R X Y Y L T D D H H M M S S m m

NOTE:

The return time "mark" is when the decoder receives the read time **01** or **A** command.

Values for nibbles are shown below with bits numbered from 0 (LSB) to 3 (MSB):

R Bits 2,3 indicate receive status as follows:
- 00 = inactive
- 01 = receive
- 11 = noisy reception

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

X Bit 3 is set to 1 when flags are validated

Bits 0-2 indicate hours X 10 since last update

YY Years from 0 to 99 BCD

L Bit 3 indicates leap second pending

Bit 2 is leap second sign
- 0 = Delete (+ UT1 Correction)
- 1 = Insert (- UT1 Correction)

Bit 1 is set if leap year in progress

Bit 0 indicates century (valid from 1990 to 2089)
- 0 = 1900
- 1 = 2000

T Bits 2,3 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

Bit 0,1 indicate days X 100

DD Days from 00 to 99 BCD

HH UTC hours 00 to 23 in BCD

MM Minutes from 00 to 59 in BCD

SS Seconds from 00 to 59 in BCD

mm Milliseconds x 10 from 00 to 99 in BCD

Command 02/B Initiates a diagnostic/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.

Command 03/C Initiates a receive update cycle. Upon reaching a time quality factor of 3 and flag correlation, time reception will be terminated.

Command 04/D Returns a two nibble UT1 time correction as follows:

High nibble

Bit 2 is set to 1 for minus correction

Bit 1 is set to 1 for plus correction

Bit 0 is set to 1 if leap second pending

Low nibble indicates UT1 correction in 100's of milliseconds

Command 5/E Returns firmware information with high nibble indicating major release and low nibble indicating revision.

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 **01** or **A** command will return the following time message:

47 00 00 01 00 00 00 00

Upon reception of the first validated time frame, the 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 verified as indicated by flag status bit.

Automatic update mode

After initialization automatic time updates are initiated at each hour UTC. Flags verification is initated at 00 hours UTC each day. Once an update is initiated, reception continues until data is verified.

Command update mode

Time and flags may be re-verified at any time by issuing the **03** or **C** command.

Diagnostic 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, until WWVB synchronization at which time data bits are decoded and returned once a second

Power

It is recommended that the unit be powered continuously (24 hour per day operation). This allows frequent WWVB time updates to maintain accuracy.

While the unit may be powered on for short periods to receive time, it cannot be guaranteed that time reception will occur due to propagation, noise and infrequent transmitter maintenance shutdowns.

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 3V TTL level inverted data***.**
3	**Txd**	Transmitted data - serial output 3V TTL level inverted data*****.
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**	This signals allows selection of baud rate. Open is 9600 baud, shorted to ground is 2400 baud.
8	**GND**	Power and signal ground return signal line

***** RXD and TXD data is inverted for interface with industry standard RS232 interface chips.

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	22 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
Rxd to Txd delay	5 milliseconds min.
Time format	UTC, (universal coordinated time)
Data format	Packed BCD or ASCII
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

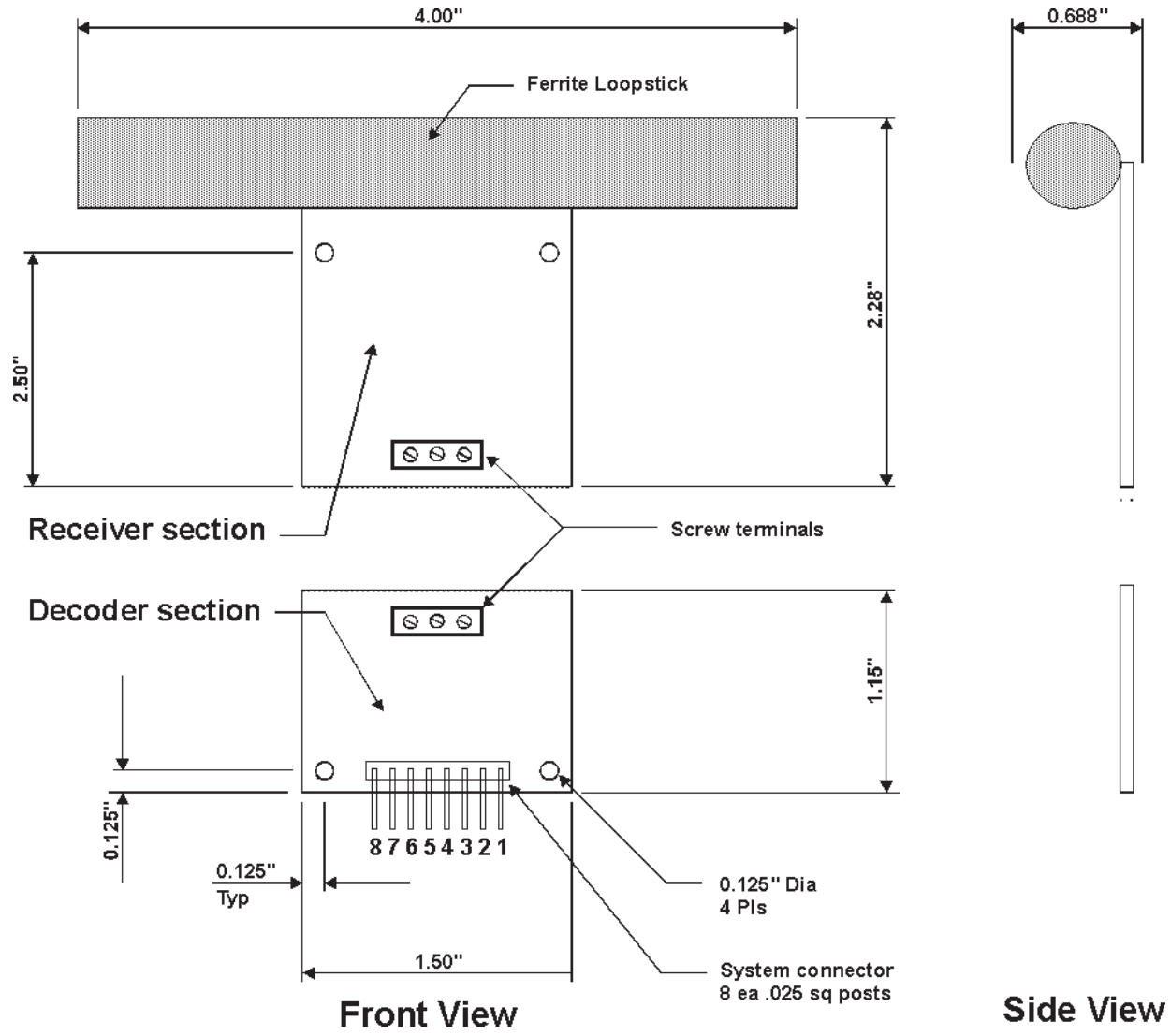
Electrical

Power	+3.5 to 15V @ 600uA

Made in the USA.

SPECIFICATIONS - *continued*

Mechanical dimensions



ORDERING

Available as "Split" only

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ULTRALINK

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