

DESCRIPTION

General

The Model 321BS provides computer readable time and date information based on the United States Atomic Clock Standard broadcast by the National Institute of Standards and Technology on WWVB.

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

Operational

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

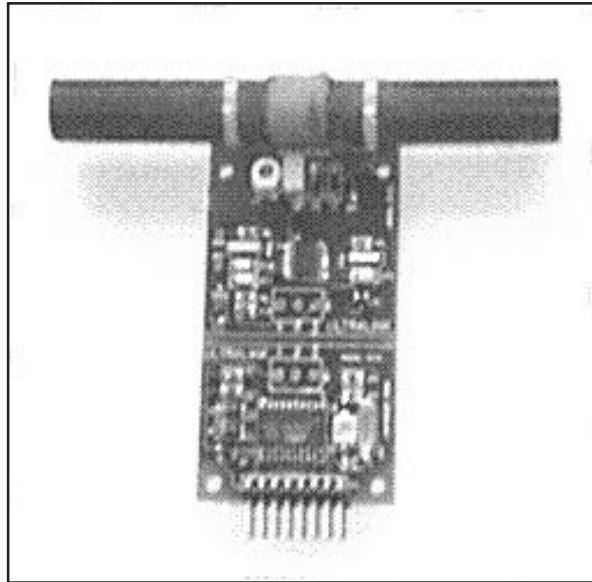
The decoder module contains a microprocessor which digitally processes WWVB time code signals, maintains an internal real time clock and supervises the serial interface. A quartz reference is used for continuous timekeeping.

Physical

The unit is constructed on 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

- Efficient BCD communication protocol
- 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
- 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. A summary of commands (in hexadecimal) follows:

| Hex | Command |
|-----|---------------------|
| 01 | Read time |
| 02 | Diagnostic receive |
| 03 | Force update |
| 04 | Read UT1 correction |
| FF | Read firmware rev |

A carriage return is not required. Invalid commands are ignored. Bits are numbered from bit 0 (LSB) to bit 7 (MSB). A description of command return message formats is shown below:

Command 01 Returns an 8 byte string as follows:

RX YY FD DD HH MM SS mm

NOTE:

The return time "mark" is when the decoder receives the **D** or **T** command.

RX is a byte indicating the receive status and time quality as follows:

Bits 5,6,7 indicate Update status in 10's of hours since last update

Bit 4 is set to 1 when flags are validated

Bits 2,3 indicate quality of time measured by number of correlating frames received.

Bits 0,1 indicate receive status as follows:

00 = inactive

01 = receive

11 = noisy reception

YY Years from 0 to 99 BCD

FD Bit 7 indicates leap second pending

Bit 6 is leap second sign

0 = Delete (+ UT1 Correction)

1 = Insert (- UT1 Correction)

Bits 5,4 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 3 indicates century (valid from 1990 to 2089)

0 = 1900

1 = 2000

Bit 2 is set to 1 if leap year in progress

Bit 0,1 indicate days X 100

DD Days from 0 to 99 BCD

HH 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

mm Milliseconds from 0 to 99 in BCD

Command 02 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 Initiates a receive update cycle. Upon reaching a time quality factor of 3 and flag correlation, time reception will be terminated.

Command 04 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

Command FF 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.

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:

E1 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 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 . 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.

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, followed by WWVB synchronization lock. After this data bits are decoded and returned once a second

Power

It is recommended that the unit be powered continuously (24hour 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:

| <u>Pin</u> | <u>Signal</u> | <u>Definition</u> |
|------------|---------------|--|
| 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 | AUX | Signal may be programmed by factory for specific customer requirements. |
| 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 | 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 |
| Protocol | 8,1,N |
| Time format | UTC, (universal coordinated time) |
| 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 x 1.15 H x .25 T (see outline drawing) |
| Weight | 0.5 lb |
| Construction | Printed circuit board |

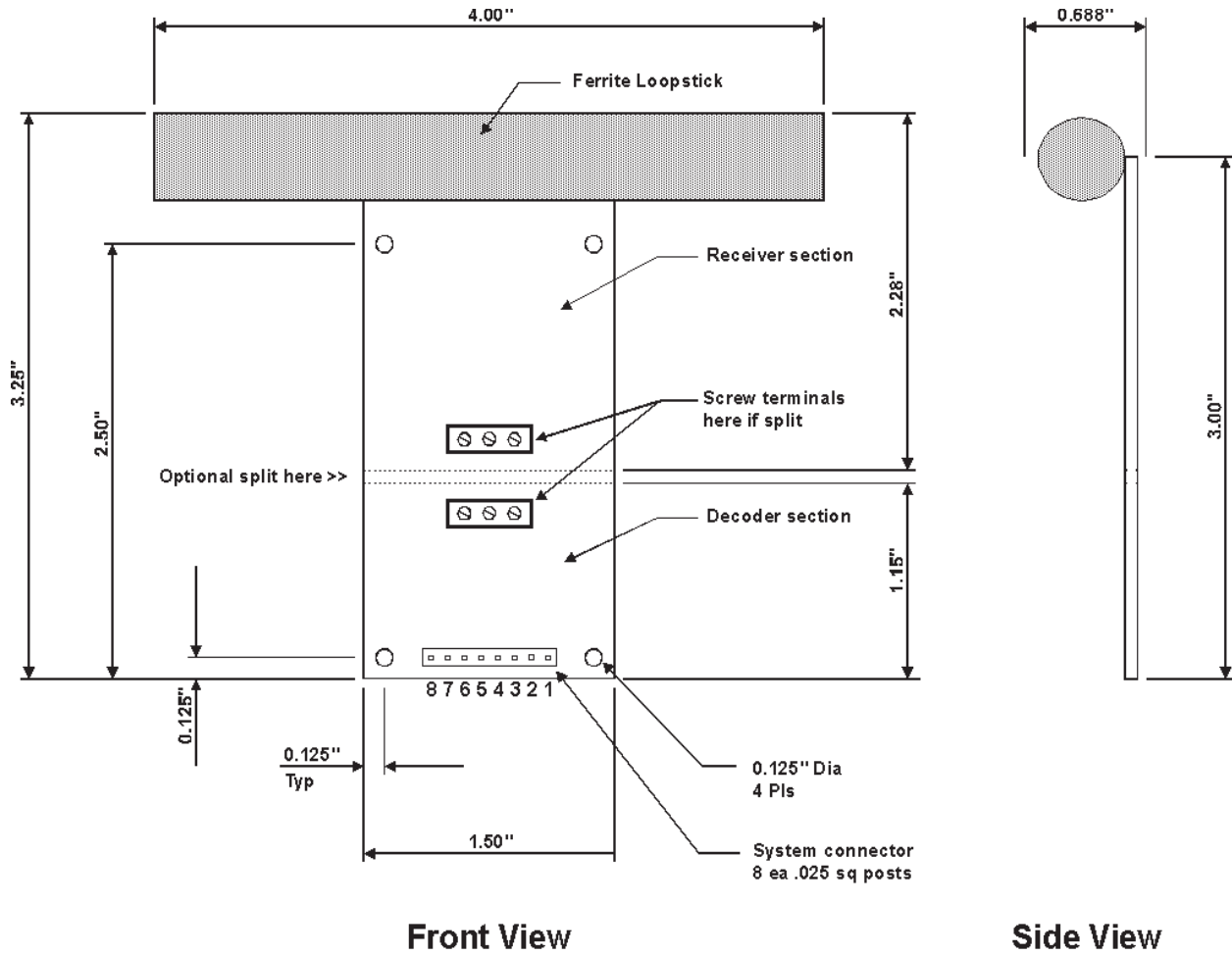
Electrical

| | |
|-------|---------------------|
| 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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