

ULTRA LINK

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WWVB Receiver/Clock with RS232 Interface

DESCRIPTION

This system provides a computer readable clock/calendar with accuracy based on the United States Atomic Clock Standard. The system receives signals broadcast by Radio Station WWVB operated by NIST (National Institute of Standards and Technology).

UTC time (universal coordinated time) and date information is read via a RS232 communication link.

The system is designed for applications where accurate time is essential to system operation and data integrity. The M320 is designed for use in embedded applications where the host computer is operational 24 hours per day.

FEATURES

- Year 2000 compatible
- 0.1 second accuracy
- Leap year, second and daylight savings flags
- ASCII communication protocol
- 1 PPS TTL output
- RS232 powered
- Dual crystal filters for maximum selectivity
- Large tuned loopstick antenna for maximum sensitivity
- Internal clock for loss of signal periods
- Synchronous time code detection

APPLICATIONS

- Embedded system real time clock
- Remote data acquisition and logging
- Timers/sequencers
- Personnel time clocks
- Office equipment
- Entry systems
- Automatic reporting systems
- Traffic signal synchronization
- Telephone system timekeeping
- Security systems
- Tamper-proof time stamping



FUNCTIONAL DESCRIPTION

The M320 consists of two elements - the WWVB receiver and RS232 decoder.

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

The decoder module contains a microprocessor used to decodes WWVB time code signals maintain an internal real time clock for readout by the host. A quartz reference is used for continuous timekeeping. A RS232 interface provides communications signals to the host. Power circuitry develops internal operating voltages from RS232 signals.

OPERATION

For best results See INSTALLATION instructions on last page before starting operation.

Commands and responses

All operation is by RS232 serial data port. Commands and data use computer industry standard ASCII communication characters. A summary of commands follow:

ASCII	Command
D	Returns incoming data bit stream.
d	Terminates incoming data stream return.
G	Initiates WWVB reception/update.
g	Terminates WWVB update.
I	Returns an ID message.
L	Returns hours since last update.
R	Initiates auto time message at completion of each WWVB update cycle.
r	Terminates auto time message mode.
S	Returns ASCII bell at signal transitions.
s	Terminates bell reception.
T	Returns time message.

A description of commands, usage and return message format follows:

Diagnostics returns WWVB data bits as they are received. Data bits are coded as follows:

- 0 = Zero
- 1 = One
- 2 = Mark
- 3 = Unknown (bad)

The decoder sends bits in sequence until a double mark is received. It then sends a carriage return. Bit patterns are in one minute packets. The data stream appears as shown below:

```
0010001120000000112.....1210000001122<cr>
0010010020000000112.....1210000001122<cr>
```

This command is useful for detecting noisy reception (a series of 333's) or direct observation of WWVB data.

The diagnostic mode is terminated by sending a **d**.

Get time initiates a receive/real time clock update cycle. Upon reaching a time quality factor of 5 and flag correlation, time reception will be terminated. In the event that the received signal is noisy, reception will be terminated with an automatic retry scheduled at the beginning of the next hour.

The get time mode may also be terminated by sending a **g**.

Identify returns model/revision information as follows:

```
<cr><lf>ULM320.D<cr>
```

The last character indicates the firmware version.

Last update returns a number indicating hours since last WWVB reception and RTC update as follows:

```
<cr><lf>NN<cr>
```

The value of **NN** is in hours from 00 to 99. For times over 99 hours the count remains 99.

Report initiates a mode where the time message is sent at each update of the internal real time clock .

This mode is used for interrupt driven host update as well as diagnostics.

This mode is terminated sending an **r**.

Signal strength mode allows for antenna orientation by using the host terminal bell (beep).

If reception is possible, the bell will sound at each decoded signal transition. Adjust antenna orientation to obtain a steady bell rate of rate of once per second.

Time command results in the current time message. The message contains 27 characters as follows:

```
<cr><lf>SQ YYYY DDD+HH:MM:SS.mmLT<cr>
```

Data format for each field is as follows:

S Indicates synchronization within last 24 hours otherwise flag is set to **?**.

Q Is quality of time data as measured by number of correlating time-frames from 0 to 5.

Note:

Correlating frames do not have to be sequential (noisy or incomplete frames are ignored).

YYYY = Current year from 1990 to 2089.

DDD = Current day of year from 1 to 366.

+ Flag indicates the current year is a leap year. This position is a space if not leap year.

HH = UTC hour of the current day from 0 to 23.

MM = Minutes of current hour from 0 to 59.

SS = Seconds of current minute from 0 to 59.

mm = 10's of milliseconds of the current second from 00 to 99.

OPERATION - continued

L Flag indicates leap second pending at the end of the current month. This field is set as follows:

- <sp>** No leap second pending
- +** Positive leap second pending
- Negative leap second pending

T Flag indicates standard (STD) and daylight (DST) status as follows:

- S** STD.
- I** Transition Into DST from STD. Set at 0000Z on first DST day and changed to a **D** 24 hours later.
- D** DST.
- O** Transition Out of DST to STD. Set at 0000Z on first standard time day and changed to **S** 24 hours later.

A typical time readback message is as follows:

```
<cr><lf>S5 1998 214 19:47:55.47 S<cr>
```

Note:

The time return "mark" is when the M320 receives the **T** command.

Initialization

When powered up, the M320 initiates a reset cycle which lasts 2 seconds. Commands sent to the M320 during the reset cycle will be ignored.

The M320 may be reset by disabling the RS232 **RTS** signal for approximately 5 seconds and then re-enabling it.

Upon initialization the "get time" mode is initiated internally. In this case the reception continues regardless of noise (unless terminated by the **g** command) until time and flags have been verified .

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

```
<cr><lf>?0 0000 000?00:00:00.00??<cr>
```

Reception of the first time frame takes 1 to 2 minutes. Upon reception of the first valid time frame, the **T** command will return a time message with a quality factor of 1.

Time verification is reached with quality factor of 5. While time may be accurate on the first frame, for maximum confidence allow the quality factor to reach **4** or **5**. Flags will remain **?** until verified by three consecutive identical readings.

After initialization automatic updates are initiated at each fourth hour UTC. In the event that the received signal is noisy, reception will be terminated with an automatic retry scheduled at the beginning of the next hour.

Operating modes

Operating modes may be independently invoked and terminated. As an example, operation using the diagnostic and report modes will return the incoming bit stream with the time message sent at each RTC update. Current time may be read at any time using the **T** command.

Host programming

A QuickBasic PC demo program follows:

```
INIT   CLS
       OPEN"COM1:9600,N,8,,CS0,DS0"FORRANDOMAS#1LEN=256
       PRINT "Enter a SEND command at any time"

MAIN:  A$=INKEY$
       GOSUBPRMSG
       IF AS="" THEN GOTOMAIN
       PRINT
       PRINTA$;">"
       PRINT#1,A$;
       GOTO MAIN

PRMSG: B$=INPUT$(LOC(1),#1)
       IF B$="" THEN RETURN
       SOUND 1000,.1
       PRINTB$;
       RETURN
```

Using this program, ASCII commands are entered on the PC keyboard. The PC monitor displays the returned message. On the **D** command a tic will be heard for each bit received. The tic is heard approximately 65 milliseconds after the beginning of each second.

Program notes:

1. The "COM" port used is specified in the second program line.
2. The Receiver/decoder is operational (powered) only while the program is running.

INSTALLATION

Connect decoder module to the host using standard 25 pin RS232 serial port connector. A null modem cable is not required when connecting to a standard PC.

The host RS232 interface must insure the RTS signal is in the active state (high or + output voltage). All communication is by the TXD and RXD lines only.

Locate receiver unit in a good reception area such as near a window or in an attic. The receiver will operate inside many types of buildings, however it will not operate inside a metal enclosure. Avoid locating near suspected interference sources such as:

- Lamp dimmers
- Fluorescent lamps
- Electronic igniters
- Computer displays
- Computer switching power supplies
- Battery chargers
- Motors
- Power lines
- Automobile ignition systems
- Nearby radio transmitters

Note:

Interference diminishes as the square of the distance from the source. Where the receiver may not operate near some interference sources it may operate 10 feet away.

Once located, connect decoder to receiver using modular telephone cable supplied. If longer length is required to move antenna away from noise sources, use a cable with 1 to 1 wiring (normal telephone modular cables are reversed).

For final antenna orientation use the **S** command as described under OPERATION. For best results unit should be broadside to Fort Collins, Colorado. After final orientation mount receiver on shelf or wall (double sticky tape is OK).

Reception hints

For tuning, reception is usually best at night.

Full time reception is not required for operation of the Model 320, however effort should be made to maximize reception periods to enable frequent time updates from WWVB to assure maximum real time clock accuracy.

The unit has been designed to accommodate intermittent loss of reception during thunderstorms or diurnal fading (caused by multiple signal paths occurring during the day/night/day transition along the signal path).

SPECIFICATIONS

Operational

Transmitter received	WWVB
Receive frequency	60 kHz
Transmitter location	Ft. Collins, Colorado USA
Reception	>20 hours/day @ 100uV/meter signal strength
Time acquisition	5.5 minutes to quality factor = 5 during good signal reception periods
Clock accuracy	+/- 0.02 sec upon reception, .02 sec/hour drift between updates or during loss of signal periods.
Date range	Indicates correct year from 1990 to 2089
Baud rate	9600
Protocol	8,1,N
Data latency	10 mSec
Receiver enable	Upon power up and every four hours thereafter
1 PPS signal	50% duty cycle TTL level available on DCD pin. Low to high transition indicates beginning of second

Physical

Data connector	DB25F
Receiver cable	100' maximum length
Cable connector	RJ11-4/6 Wired pin 1 to pin 1
Receiver	
Size	5.2" L X 2.6" W X 1" H
Weight	0.5 lb
Construction	Polystyrene enclosure
Decoder	
Size	2.8" L X 2.3" W X 0.8" H
Weight	0.2 lb
Construction	Plastic enclosure

Electrical

Power	+/-5 to +/-12V @ 1mA derived from RS232 signals. RTS signal must be set active (+ output voltage).
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Environmental

Operating temp	+10 to +35 C
Storage temp	-40 to +70 C

ORDERING INFORMATION

Order Model 320. Requires adapter for use with DB9 serial port. Ultralink adapters available are:

DB9F/DB25M 1' long cable adapter	P/N 1266
DB9F/DB25M connector adapter	P/N 1267

See Ultralink OEM price list for pricing.

For special applications, contact factory with requirements.

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