

### DESCRIPTION

#### General

The Model 320 provides computer readable UTC time (universal coordinated time) and date information based on the United States Atomic Clock Standard.

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

Computer interface is via industry standard RS232 communication link

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

#### Functional

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

The receiver module uses a loopstick antenna to receive WWVB signals. A integrated circuit receiver amplifies and demodulates the WWVB signal.

The decoder module contains a microcomputer which digitally processes WWVB time code signals. This computer also maintains an internal real time clock and provides RS232 interface. A quartz reference is used for accurate timekeeping. Power supply circuitry develops internal operating voltages from RS232 signals.

#### Physical

The receiver module is located in an enclosure which allows mounting in a location convenient for reception.

The decoder module is contained in the RS232 connector housing.

The units are connected via a modular cable which can be up to 100 feet in length.



### FEATURES

- Year 2000 (Y2K) compliant
- 0.1 second accuracy
- Leap year, leap second and daylight savings flags
- 1 pulse per second output
- ASCII communication protocol
- RS232 powered
- Internal clock for loss of signal periods
- Crystal filter for maximum selectivity
- Tuned loopstick antenna for maximum sensitivity

### APPLICATIONS

- Embedded system real time clock (RTC)
- 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

## 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
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:

**D** diagnostic 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.

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

**I**dentify returns model/revision information as follows:

```
<cr><lf>ULM320.E<cr>
```

The last character indicates the firmware version.

**R**eport 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**.

**S**ignal 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.

**T**ime command results in the current time message. The message contains 28 characters as follows:

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

Data format for each field is as follows:

**S** indicates synchronization within last hour. If **0** to **9**, indicates hours since update x 10, 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).

**R** indicates reception in progress. **N** indicates reception in progress is noisy. **<sp>** indicates receiver in standby.

**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

**I** Insert leap second at end of month

**D** Delete leap second at end of month

**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 return time "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, 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 hour UTC.

### Operating Modes

Operating modes may be invoked and terminated independently. As an example, operation in the **D**iagnostics and **R**eport modes will return the incoming bit stream with the time message sent at each RTC update. Current time may be read randomly using the **T** command.

### 1PPS Output

The 1 pps signal is output only after reception of the first valid minute is received. At this time the signal is synced to WWVB within 20mSec. This error is due to distance from transmitter, signal strength and receiver jitter. This signal will drift with internal RTC drift and will be re-synchronized at each WWVB reception/RTC update.

### 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 a standard 25 pin RS232 serial port connector. A null modem cable is not required when connecting to a standard PC. RS232 pin assignments are as follows:

Pin 2	RXD
Pin 3	TXD
Pin 4	RTS
Pin 7	GND
Pin 8	1PPS (DCD)

The host RS232 interface must insure the RTS signal is in the active state (high or + output voltage).

Locate the receiver 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	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).

Once located, connect the decoder to the receiver using the modular telephone cable supplied. If longer length is required to move the receiver 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 the unit should be broadside to Fort Collins, Colorado. After final orientation secure receiver to prevent inadvertent movement (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; an 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 and electrically noise free environment
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
Receiver enable	Upon power up and on every hour 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 feet 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

Made in the USA

## ORDERING INFORMATION

Order Model 320. Requires adapter for use with DB9 serial port. 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.

# ULTRALINK

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