

# SPECTRACOM NETCLOCK/2 RECEPTION

## SECTION 1: INTRODUCTION

The NetClock/2 is designed to provide years of trouble-free operation without requiring routine calibration or maintenance. Under rare circumstances an installation may experience poor reception quality. This may cause the clock to lose or never acquire WWVB synchronization. This condition is typically caused by local interference.

Front panel indicators provide notification that a reception problem exists. This Application Note contains information on troubleshooting Netclock/2 reception problems.

Test equipment that will assist in troubleshooting reception problems includes a laptop PC, standard serial cable, an analog or digital multimeter, oscilloscope and a signal generator.

## SECTION 2: TROUBLESHOOTING RECEPTION PROBLEMS

Netclock/2 Reception problems are often detected by the status of the front panel Antenna, Signal and Time Sync lamps. Whenever any of these lamps are red, a problem exists which may prevent WWVB synchronization.

The following paragraphs should be used as a guideline to help you identify and isolate the cause of the reception problem. The problem could be a combination of more than one factor that is causing the reception issue. Contact Spectracom's Customer Service Department for assistance in troubleshooting and repair information. Customer Service is available Monday through Friday, 8:00 AM to 5:00 PM Eastern Time at (585) 321-5800.

### 2.1 Antenna Lamp

A green Antenna lamp indicates that the antenna is connected and the antenna cable is good. The Antenna lamp is driven by a comparator which monitors the DC voltage present on the Antenna connector. This voltage powers the Model 8208 and 8206A active antennas and the Model 8207 Inline Preamplifier, if installed. The comparator window ranges from 2.0 to 8.0 VDC. **Whenever the antenna voltage falls outside this window, the Antenna lamp is red.** This usually indicates that a cable open or short exists. This may have been from construction occurring at the site where a cable has been cut or disconnected. It can also indicate a bad crimp on the cable. It could also indicate surge or lightning damage to the Netclock/2.

To troubleshoot this condition, remove the antenna cable from the clock. With a DC voltmeter, measure the antenna voltage output from the NetClock/2. Place the positive lead on the BNC center and the negative lead on the shell. The voltage under this no-load condition is 10.7 VDC. If no or low voltage is present, the NetClock/2 has a failure; contact Spectracom.

To test the antenna cable, temporarily place a BNC “T” connector onto the antenna cable. Reconnect the antenna to the clock and measure the antenna voltage using the “T” connector. Typical voltage is around 4vdc. If the voltage falls to 0 VDC, a short exists. If the voltage remains at 10.7 VDC, an open exists. Check the coax, connectors and surge arrestor for failures.

If the antenna voltage measures within the comparator window of 2.0 to 8.0 VDC but the antenna lamp is still red, the comparator circuit has failed. This failure could be due to lightning damage; contact Spectracom.

Also check the continuity of the cable disconnected from the Netclock/2 from center conductor to shield. The next page lists the resistance values based on the specific antenna configuration.

## RESISTANCE VALUES OF ANTENNAS AND PREAMPS

Model 8206 active loop by itself ~6 Mohms

Model 8206A active loop antenna by itself ~6 Mohms

Model 8207 preamp (output side) with Model 8219 antenna ~ 12.2 kohms

Model 8207 preamp by itself ~ 3 Mohms

Model 8219 passive antenna by itself ~6.7 kohms

## 2.2 Signal Lamp

This lamp indicates the receiver phase lock status to the WWVB carrier. The lamp is green when the receiver is phase locked, and red when it is not. In addition to lock status, this lamp blinks red and green when a VCXO adjustment is needed. Contact Spectracom if this condition exists. An alignment procedure will need to be performed.

In most installations, carrier lock is easily maintained by the receiver. An occasional loss of lock can be considered normal. Typically, the receiver reacquires phase lock within minutes. During winter months, the WWVB antenna can accumulate ice. This is rare, but when this does occur, the carrier may be reduced for a few hours. Contact Spectracom to verify signal quality whenever carrier lock is lost for more than a one-hour period.

It is not considered normal for the receiver to lose lock on a regular basis. Typically, this problem is solved by relocating the antenna. Follow the instructions described in *Section 3.1, Signal Strength Measurement* and Figure 3-3 when finding a new antenna location. Select the location which yields the highest AGC voltage. If the maximum obtainable AGC voltage is less than 1.8 VDC, the antenna or preamplifier gain or tuning could be the problem. The preamplifier may also be installed backwards. Contact Spectracom for replacement or repair service.

If the Signal lamp is constantly red, the problem could be either the antenna or receiver, or extreme saturation. Troubleshooting this symptom requires an oscilloscope, multimeter and possibly a signal generator. Contact Spectracom for additional information.

## 2.3 Time Sync Lamp

When a receiver is unable to achieve or maintain WWVB synchronization, the problem is usually due to local interference. The Time Sync lamp is red when any of the following conditions are true:

1. During initial operation or after a power failure.
2. The receiver has lost phase lock to WWVB for a period greater than one hour.
3. The receiver has not decoded a minimum of five consecutive error-free minutes over the past 24 hours.

The NetClock/2 includes a test mode feature to assist in troubleshooting reception problems. While in the test mode, the tens of hours digit displays the receiver WWVB time code bit every second. This feature is useful because it provides an instant indication of the received signal quality. To enter the **IRIG FORMAT TEST** mode, place the IRIG Format switch into Position 9.

In the test mode, the left-most display digit shows valid time code characters as the numbers 0, 1, and 2. When a 0 is displayed, the receiver decoded a Binary 0 for that time code bit. A number 1 represents a Binary 1 was received. Every ten seconds, WWVB transmits a position identifier. This character is represented by the number 2. The pulse width of the demodulated time code determines which character was received.

If the received time code character does not meet the criteria for a Binary 0, Binary 1 or position identifier, it is considered invalid and is ruled a bit error. A bit error is represented by the number 4 on the display. Displaying frequent or constant bit errors is cause for concern, as the time required to synchronize is greatly extended. Bit errors may be caused by solar flares, poor atmospheric conditions, or local interference. Little can be done about the sun or weather, but local interference problems can be solved. Interference can be conducted over the power line and ground or radiated into open air. Refer to the next three paragraphs for additional information.

### 2.3.1 UPS Concerns

A possible source of power line noise is the Uninterruptible Power Supply, or UPS. The switching frequency of the DC to AC converters found in the UPS may disrupt the NetClock/2 receiver. If the NetClock/2 is connected to a UPS, temporarily power the clock from an unprotected outlet. Note the rate of bit errors displayed prior to changing the power source. If the Netclock/2 is installed near a UPS try locating the clock away from the UPS.

### 2.3.2 Grounding

Try connecting the rear panel Chassis Ground stud to a known good earth ground. If no improvement in signal quality is detected, the problem is due to radiated interference.

### 2.3.3 Radiated Interference

This type of reception problem is often solved by either relocating the antenna or trying a different type of antenna. Try to locate the current antenna outdoors and as far away as possible from any RF generating sources (i.e other transmitting antennas, RADAR from a nearby airport, Air Conditioning equipment, UPS's, High Voltage power lines, etc). Keep the antenna at least three feet from metal and other WWVB antennas.

If the antenna is installed on an antenna tower, try a rooftop location. If no improvement in signal quality is shown, the problem could be due to antenna saturation caused by local interference. To verify the problem is site-related and not equipment-related, try temporarily moving the clock off site.

If the clock time syncs offsite, and you are using a Model 8208 whip antenna or a Model 8206(a) active antenna, consider trying a Model 8219 Passive antenna along with a Model 8207 preamplifier. The Model 8219 antenna and the Model 8207 preamp combination are the best solution for minimizing saturation. Spectracom has a demo program that allows you to try this system before purchasing. Contact Spectracom for details on this demo program.

If the clock time syncs offsite and you already have the Model 8219 antenna, consider changing out the WWVB clock system for one of our GPS-based clock systems. Contact our Sales Department for pricing information. If you have any questions regarding a change-out of equipment, please contact our Technical Support Department for assistance.

### 3.1 Signal Strength Measurement

The NetClock/2 may be used to measure the relative field strength of the 60-kHz WWVB signal. This measurement is used to optimize reception by indicating the best location and orientation of the antenna. This is especially useful for the Model 8219 Loop Antenna, due to its directional reception pattern.

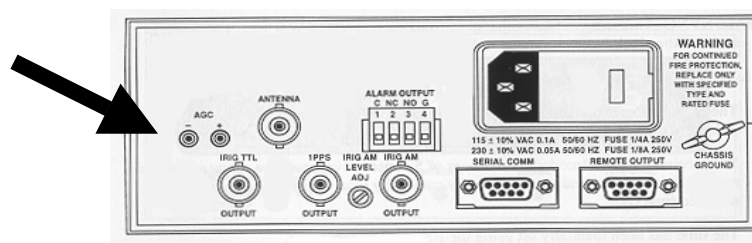
The NetClock/2 employs synchronous AGC which responds to the 60-kHz signal only, and is not affected by noise. The AGC level, therefore, provides an excellent indication of field strength.

The AGC voltage increases in strong signal locations, rising to a limiting value of approximately 3.6 VDC. The AGC voltage is approximately 2.3 VDC at a field strength of 100  $\mu$ V/meter using a properly-oriented Model 8219 Loop Antenna and Model 8207 Preamplifier. The AGC voltage increases in strong signal locations, rising to a limiting value of approximately 3.6 VDC.

As the signal strength decreases to the receiver phase lock minimum threshold of about 0.2  $\mu$ V, the AGC voltage decreases to about +1.0 VDC. The SIGNAL lamp changes from green to red below this level. The AGC voltage will decrease to a varying level around zero if the input signal is removed completely. As the signal is reapplied and increased, the receiver will again lock at an AGC level of approximately 1.0 volt.

#### 3.1.1 Measure the AGC Voltage on a Black Enclosure NetClock/2

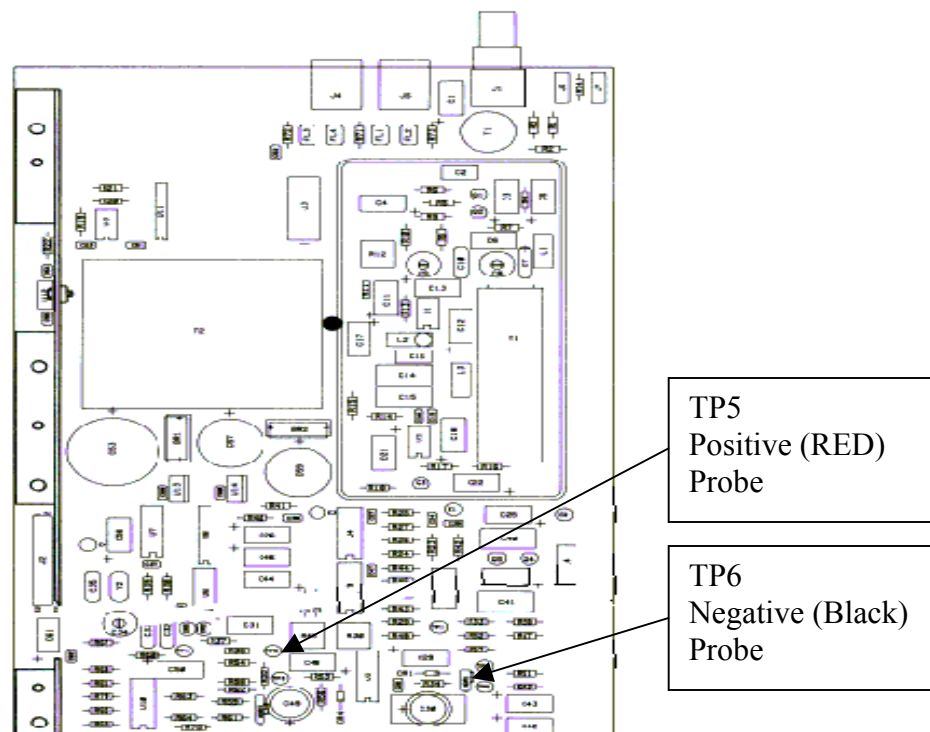
Connect a DC voltmeter to the rear panel AGC test points. Refer to Figure 3-1 below. The AGC voltage is approximately 2.3 VDC at a field strength of 100  $\mu$ V/meter using a properly-oriented Model 8219 Loop Antenna and Model 8207 Preamplifier.



**FIGURE 3-1.** AGC Test Point Location for Black Enclosure Netclock/2

### 3.1.2 Measure the AGC Voltage on a Beige Enclosure NetClock/2

The top cover of the clock needs to be removed to access the AGC test points located on the receiver board. Refer to Figure 3-2 below. Turn the clock upside down and remove the two indented screws that hold the bottom cover to the top cover. Turn the clock back upright and carefully remove the top cover. Connect a DC voltmeter to the AGC test points. The AGC test points are located on the top PC board. The Black probe should go to TP 3, and the red probe should go to TP 5. The AGC voltage is approximately 2.3 VDC at a field strength of 100  $\mu$ V/meter using a properly-oriented Model 8219 Loop Antenna and Model 8207 Preamplifier.

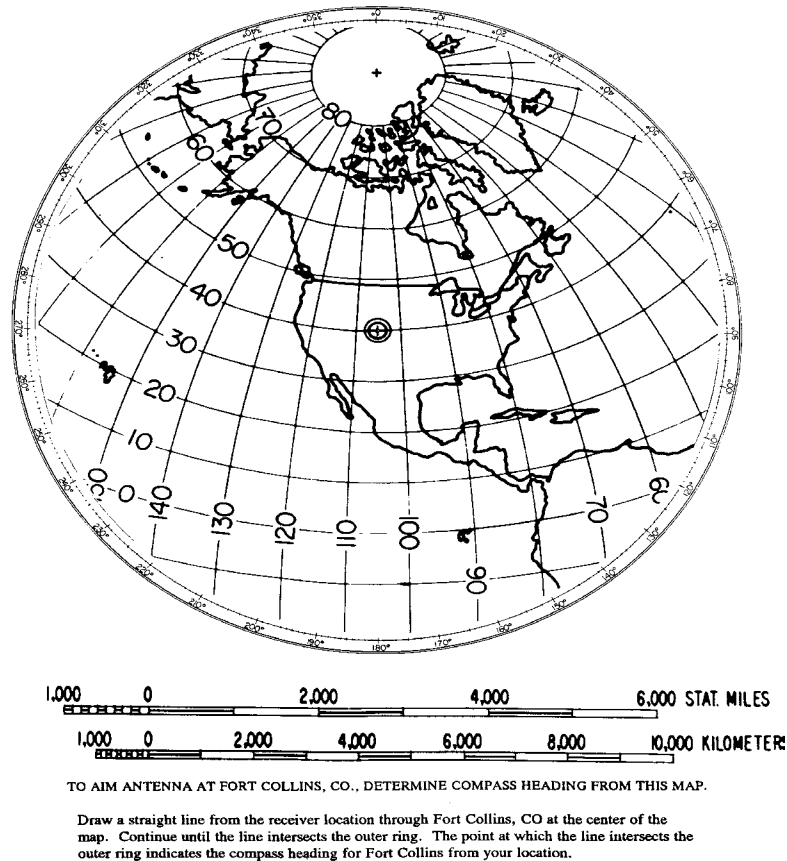


**FIGURE 3-2.** AGC Test Point Location for Beige Enclosure Netclock/2

### 3.2 Antenna Alignment

The relative signal strength measurement may be used to aid antenna orientation by placing the antenna so as to maximize the AGC voltage measurement. The circuit that develops the AGC voltage has a very long time constant. A pause of 30 to 60 seconds is necessary after each move of the antenna to allow the AGC to stabilize. A few minutes of experimentation should produce optimum antenna orientation.

The Great Circle Map shown in Figure 3-3 is used to determine the correct antenna orientation per receiver location. Follow the instructions below the map scale to determine a compass heading. The antenna position may be optimized using the AGC measurements described in *Section 3.1, Signal Strength Measurement*.



**FIGURE 3-3.** Compass Orientation for Directional Antenna

#### 4.1 Signal Quality Log Command

The Netclock/2 has a built-in Signal Quality Log. A laptop PC running HyperTerminal or Procomm and a standard straight-thru Serial cable are required to obtain the log. Sending a capital letter R to the clock outputs the Signal Quality Log report. The report contains an hourly count of good compare minutes and the number of times phase lock to WWVB was lost over the last 24 hours. The report is updated at the end of each hour and continuously overwrites previous data contained in that hour location. An example of the Signal Quality Log is shown below:

SIGNAL QUALITY LOG					
HOUR END	COMPARE MINUTES	LOST LOCK COUNTER	HOUR END	COMPARE MINUTES	LOST LOCK COUNTER
0	60	00	12	60	00
1	59	00	13	60	00
2	60	00	14	60	00
3	60	00	15	60	00
4	60	00	16	60	00
5	60	00	17	60	00
6	60	00	18	49	01
7	60	00	19	34	00
8	60	00	20	60	00
9	60	00	21	60	00
10	60	00	22	60	00
11	60	00	23	60	00

The Hour End column in the report represents display time. Display time may be UTC or local time depending on how the clock was initially set up. Clocks displaying UTC time have the TIME ZONE offset switches set to zero and the automatic DST correction feature disabled.

The Compare Minutes is the number of error free minutes accumulated over each one hour period. The WWVB time code is one minute in duration and consists of 60 characters. The Netclock/2 receives this code and qualifies each character received. If a received character is ruled invalid, the Compare Minutes counter is not incremented for that minute. Invalid characters or bit errors are primarily due to poor atmospheric conditions. Local interference, solar flares, and poor antenna location or position may also contribute to a high bit error rate, resulting in a low compare minutes count.

The Lost Lock Counter is incremented each time carrier lock to WWVB is lost over that one hour period.

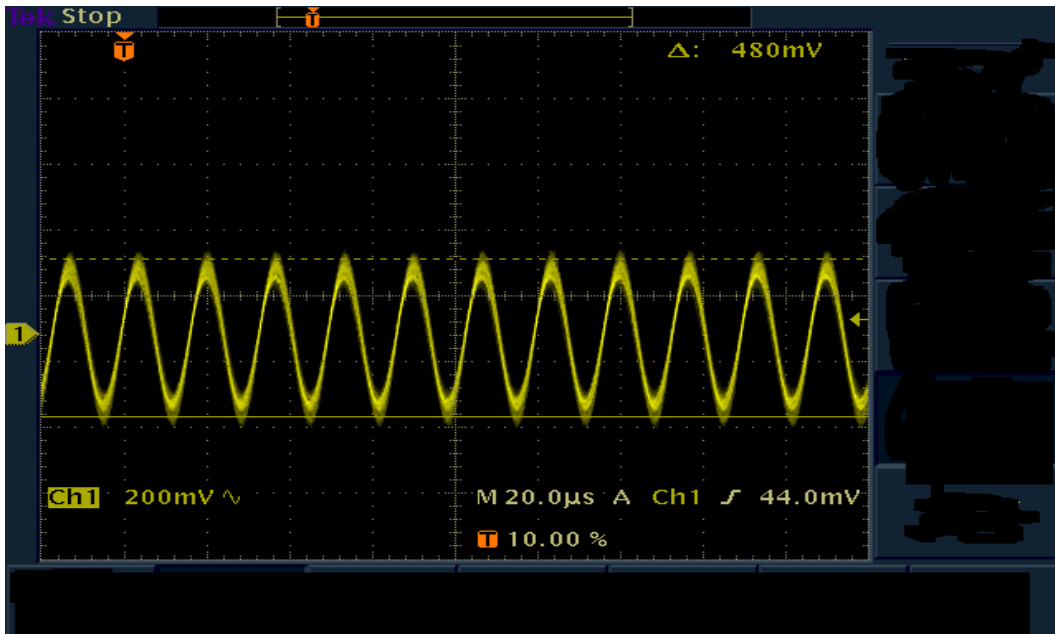
Print the log at about the same time for several days in a row to determine if there is a pattern to the reception. Contact Spectracom for assistance with evaluating the Signal Quality Log.

#### 4.1.1 Clear Buffer Command

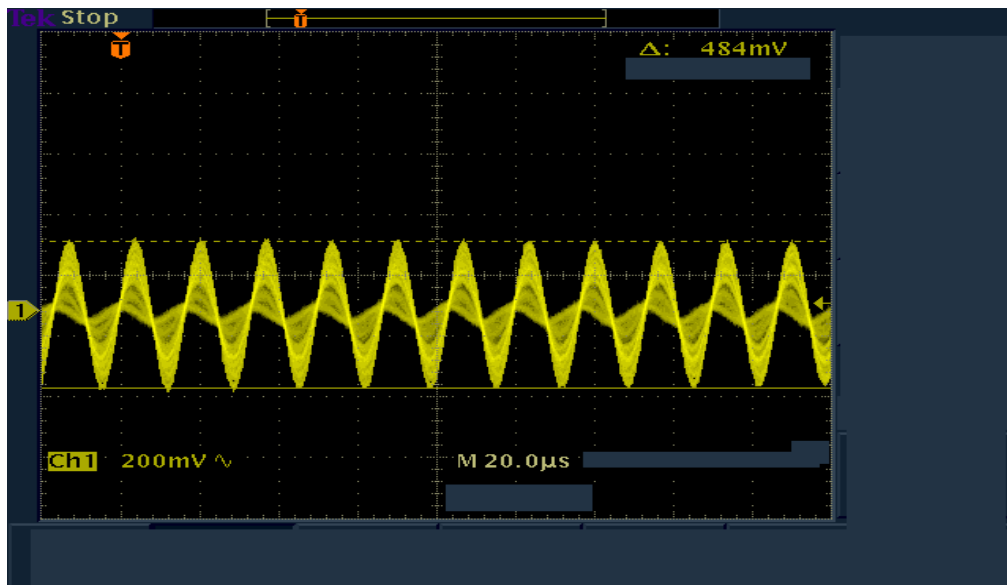
The Clear Buffer command is used to restart the Signal Quality Log. Sending the capital letters CB resets the Compare Minutes and Lost Lock Counter to all zeroes.

### 5.1 RF Amplifier Output

If an oscilloscope is available, there is a test point on the RF amplifier output, inside the Netclock/2 that allows the WWVB carrier signal to be viewed. Viewing the WWVB carrier with an oscilloscope can help define if noise or saturation is present. Connect the oscilloscope probe to TP E1 located just in front of the metal shield on the top board. Connect the probe ground to TP E2 located just to the right of TP E1. Figure 5-1 below is an example of good reception. The signal is decreased in amplitude once a second for a set duration depending on the data bit being sent. Figure 5-2 is an example of poor reception. The peaks are filled in, making the signal look like a ribbon cable. Refer to *Section 5.1.1, Signal Evaluation* for determining signal quality.



**FIGURE 5-1.** Example of Good Reception



**Figure 5-2.** Example of Poor Reception

### 5.1.1 Signal Evaluation

#### **Indications of good reception:** (Refer to Figure 5-1)

- 1) A clean sine-wave at an amplitude of about 0.48vp-p that is reduced in amplitude every second is present.
- 2) No noise spikes above or below the positive and negative lobes are present.

#### **Indications of noise or saturation at the site:** (Refer to Figure 5-2)

- 1) If there are noise spikes present above and below the sine wave.
- 2) The positive and negative lobes are filled in, making the sine-wave look more like a ribbon cable instead of a clean sine-wave.
- 3) The sine wave intermittently cuts out (becomes a straight line).

#### **Indications of a Netclock/2, Antenna or preamplifier failure:**

- 1) No amplitude modulated signal present at TP E1.