MOD-SIX
Nixie Clock System
User's Guide

February 2018

This manual describes the installation and operation of the MOD-SIX Nixie Clock System.

Revision/Update Information:	This is a revised manual
Clock Firmware:	V09-18
RPTR-OLED Firmware:	V47
Keyfob Firmware:	V32
TimeLink receiver Firmware:	V41

http://www.badnixie.com

February 1, 2018

WARNING: This clock makes use of high voltages within the case. Never attempt to operate the clock with the cover removed.

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This document incorporates materials from H Carl Ott and Michael Barile.

Contents

FIGURES

Preface

This manual explains how to install and use the MOD-SIX Nixie Clock System.

Intended Audience

This manual is intended for all clock users. It describes the unpacking, installation, and configuration of the clock as well as providing a history of the tubes used in the clock.

Important Cautions

WARNING: DO NOT operate the clock without the cover in place - hazardous voltages are present at some locations on the circuit boards when the clock is operating.

The tubes are extremely fragile and expensive (over $100 each). Use extreme care when unpacking them from the shipping materials and installing them in the clock. **NEVER** ship the clock with the tubes installed.

DO NOT interchange the two antenna connectors on the optional RPTR-OLED. While both connectors have the same thread, they have very different functions and swapping the antennas will at a minimum cause the RPTR-OLED to not operate properly and may damage the RPTR-OLED if connected improperly and left powered on for an extended period.

NEVER connect or disconnect any cables or change the position of any hardware jumpers without first removing power to the item(s) in question. Components such as the optional PIR sensor and the GPS antenna on the RPTR-OLED are not intended for "hot-plug" operation and can cause damage to themselves or other clock components if power is not disconnected first.

Like all electronic devices, the clock components can be damaged by static electricity. When installing the clock or accessories, or changing settings on them, always touch the aluminum baseplate first to discharge any static electricity.

Useful Web Sites

- MOD-6 Google Group: https://groups.google.com/group/mod-6_7971
- NEONIXIE-L Google Group: https://groups.google.com/group/neonixie-l
- BadNixie: http://www.badnixie.com
- The Vintage Technology Association: http://www.decadecounter.com

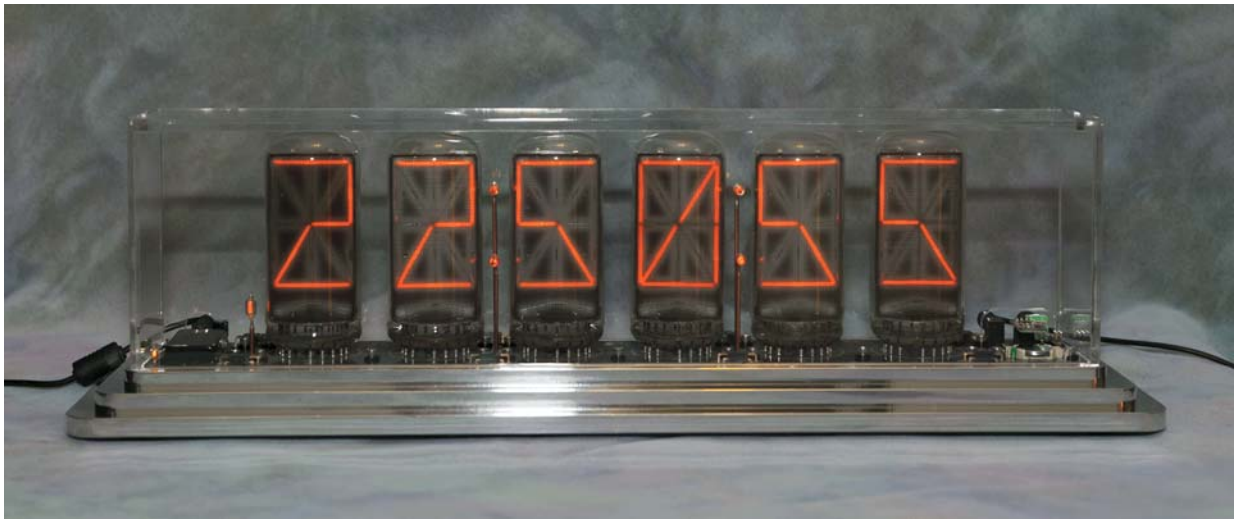
Conventions

In this document, the following conventions will be used:

- **For future use** is used to describe some items in this manual. The presence of **"For future use"** material in this manual does not indicate that the functions or options are available, nor imply any promise that they will be offered at any point in the future.
- **Clock** refers to the MOD-SIX Nixie Clock base / electronics, tubes, and acrylic cover as an assembled unit.
- **3rd-party clocks** refers to clocks from other suppliers and which are not part of the MOD-SIX product line.
- **RPTR-OLED** refers to the optional separate module and baseplate which connects to the GPS antenna and contains the CPU, random word generator and environmental sensors. It also contains a short-range radio transmitter for communicating with other components of the MOD-SIX System such as the clock, one or more TimeLink receivers (optional), and so on. While not part of the RPTR-OLED itself, its other components (GPS antenna, short-range radio antenna and power supply / cable) come as a set if the RPTR-OLED option is ordered.
- **Keyfob** refers to the optional handheld remote control.
- **TimeLink receiver** refers to the optional receiver and cable for 3rd-party clocks.
- **PIR Sensor** refers to the optional passive infrared sensor used to detect whether the room where the clock is located is occupied or not.
- UPPERCASE words generally refer to menu options, described in detail in Section 3.3 and Section 4.2.
- **Note** calls your attention to a procedure that should be followed closely. Ensure you are familiar with the relevant documentation before performing any procedures marked with **Note**.
- **Caution** indicates that you should take care to perform the referenced procedures as per the documentation, as damage to one or more clock components can happen if any procedure with a **Caution** is performed improperly.
- **WARNING** indicates that particular care needs to be taken to prevent possible personal injury.

1 Introduction and package contents

Figure 1–1 Clock in operation



This chapter describes the MOD-SIX Nixie Clock System package contents so you will know what to expect when you unpack it in the next chapter.

Note: The following applies to the assembled version of the clock. Refer to the separate assembly instructions if you purchased the clock as a kit. Certain items, such as the RPTR-OLED and its power adapter, may not be included with your clock, depending on the option(s) you ordered.

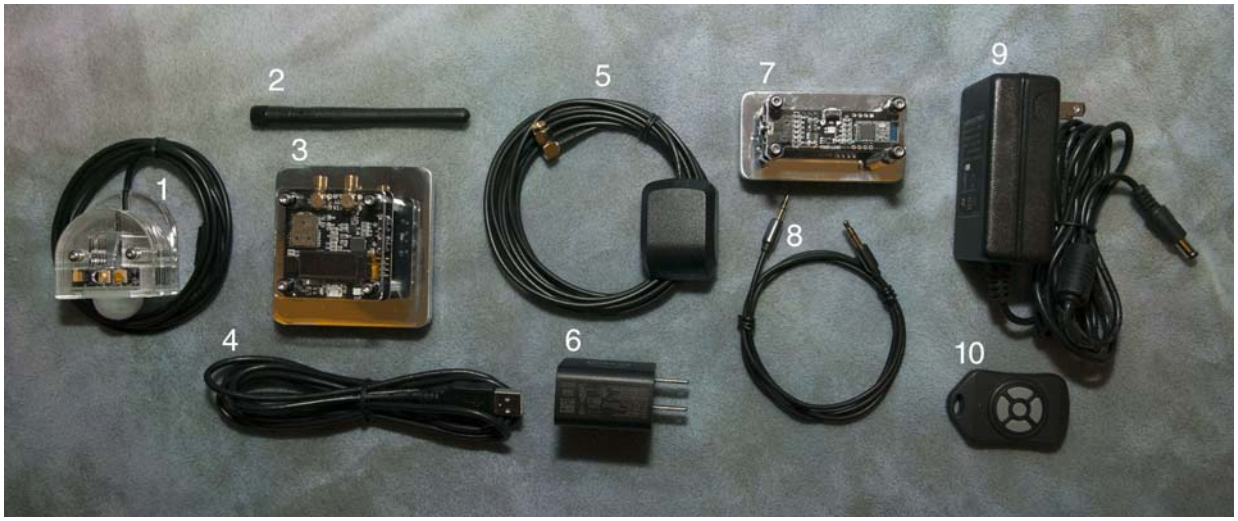
The package contains:

- This manual
- Clock base with circuit boards and colon towers
- Clear acrylic clock cover
- AC adapter for clock (round connector)
- RPTR-OLED with radio and GPS antennas (Optional)
- AC adapter for RPTR-OLED (rectangular connector) (Optional)
- Keyfob (Optional)
- PIR sensor (Optional)
- TimeLink receiver(s) and cable(s) (Optional)

You will also need:

- 6 B-7971 Nixie tubes
- Plug adapter(s) if you are outside the US
- Cotton gloves to avoid getting fingerprints on the tubes, cover and baseplate (Optional)

Figure 1–2 Other clock system components (some optional)



1 PIR sensor
2 RPTR-OLED antenna
3 RPTR-OLED
4 RPTR-OLED power cable
5 RPTR-OLED GPS antenna
6 RPTR-OLED AC adapter
7 TimeLink receiver
8 TimeLink receiver cable
9 Clock AC adapter
10 Keyfob

Note: The AC adapter(s) shipped with your clock may appear slightly different than the ones shown in the picture.

2 Unpacking and installing the clock

This chapter provides information necessary to install the clock system. Please read these instructions completely before proceeding with unpacking and setup.

Unpack each item carefully, as described below, and verify that all items are present and undamaged. In particular, take care to put the tubes somewhere where they won't roll off and break.

2.1 The clock cover and base

The clock cover is shipped on top of the clock base / circuit boards. That assembly is wrapped with plastic wrap to hold things together and then wrapped in a layer of protective foam.

Cautions: DO NOT use any sharp objects such as a razor blade or scissors during the unpacking procedure as you may scratch or otherwise damage the plastic cover or baseplate.

NEVER attempt to lift or move a clock by grasping the cover - instead, lift it out of the packaging or move it by firmly grasping the baseplate. The baseplate is quite heavy, so make sure you have a good grip on the clock and have prepared a location to place it before unpacking.

Carefully open the outer carton(s) to expose the clock and packing materials. Remove a sufficient quantity of the foam "peanuts" to allow you to reach down and lift the clock by the baseplate. Carefully lift the clock (still wrapped in its protective packaging) and position it near the desired installation location.

Remove the tape by peeling it back to allow you to unfold the protective foam and expose the inner packaging. Lift the clock (still in its plastic wrap) out of the foam and set it down. Next, carefully unwrap the plastic wrap holding the cover to the clock baseplate.

Note: You may wish to use cotton gloves at this point to avoid getting fingerprints on the clock cover and baseplate.

Remove the cover and set it aside for now. Lift the clock by the baseplate and position it in the desired installation location. Retain all packing materials in case you ever need to return anything (or in case you move).

If there is a strip of tape holding the battery in its socket on the right-hand side of the clock, remove it. Be careful to not pop the battery out of its socket when removing the tape. If the battery is removed, the clock's configuration settings will be lost and you'll have to re-enter them.

Figure 2–1 Location of shipping bumpers

Figure 2–2 Shipping bumper detail

Carefully remove the four clear plastic shipping "bumpers" from the clock, two on the front and two on the back of the clock circuit boards on the left and right black connectors. These are used during shipping to prevent the cover from shifting and becoming scratched. As the bumper is slightly larger than the connector it is attached to, you can simply peel it off by gently pulling on the top edge of the bumper.

Note: Do not remove the four similar bumpers from the bottom edge of the clock cover - they are there to keep the cover from sliding on the baseplate.

Inspect the small neon lamps (on the copper rods) for any misalignment that may have occurred during shipping. You can carefully reposition the lamps on the end of the rods if needed. If the copper rods are bent, be very careful when trying to straighten them.

2.2 Installing the tubes

Note: Tubes are not supplied with the clock and must be purchased separately elsewhere.

The tubes are nearly 50 years old and have been in and out of equipment. This will likely have caused the pins to become misaligned, so you can't simply push a tube into a socket on the clock - you'll need to adjust some of the pins first. At the same time, you may be tempted to clean off any grime which has accumulated on the tubes from their years of use and storage. We suggest making sure each tube fits into its socket and works before cleaning it, in case you need to return any to the seller in as close to "as-sold" condition as possible. Therefore, in Section 2.2.1 we provide cleaning procedures which have worked well for us, for use *after* you have verified all tubes are working correctly.

First, carefully unwrap a single tube and examine the pins on the underside. If any are bent substantially out of line, **carefully** bend them back toward the proper position. You may use needle nose pliers or your fingers for this process. Do **NOT** grasp the pins too close to the glass when straightening them - this can apply stress to the glass and possibly ruin the tube. Also, the tubes do not seat all the way into the sockets, so any slight curves in the half of the pins closest to the glass don't really matter.

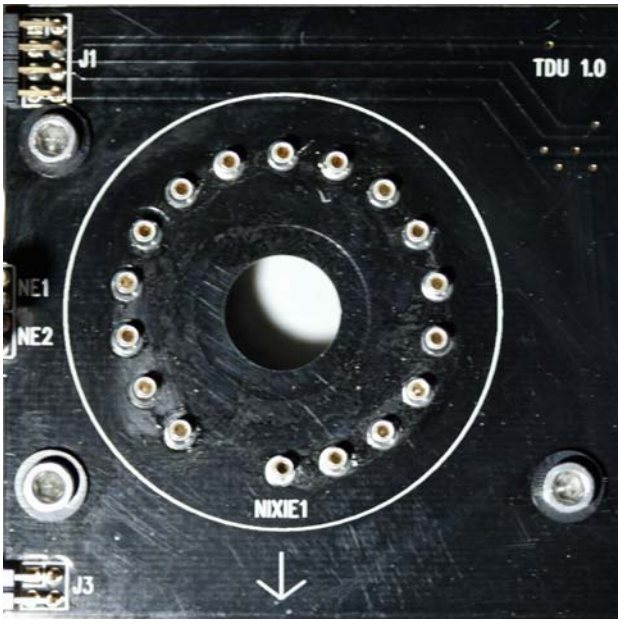
Caution: The pins are made of a rather soft metal. Take care when adjusting them to avoid bending them further than necessary.

Once you have all of the pins close to the correct positions, place the tube over one of the sockets on the clock. You should be able to position the tube with pins 1 and 17 (the ones separated by the gap) directly over the corresponding positions of the tube socket. Don't try to press the tube down yet - just hold it with those pins sitting on the socket. While continuing to hold the tube with one hand (you don't want to let go and have it fall), examine each of the other pins in relation to their corresponding socket positions. This will give you an idea which pins need to be moved and in which directions in order for the tube to fully seat in the socket. Remove the tube and perform the necessary pin adjustments. Repeat this procedure until all pins are aligned.

Note: In some cases, the correct adjustment will be to move a previously-adjusted pin slightly - if you discover a series of pins all out of line by the same amount, the problem may be with a prior pin instead.

Once all adjustments are complete, grasp the tube and hold it on top of the socket. Double-check your alignment and gently insert the tube into the socket. If the tube will not seat into the socket, check for a misaligned pin hanging up on the inner lip of a socket position.

Figure 2–3 Tube socket showing keyed pin



Caution: The hole in the circuit board is to accommodate the glass protrusion left over from when the tube was manufactured. That protrusion is one of the most fragile components of the tube, so be careful not to bump it on anything and never stand the tube on a completely flat surface.

After making sure each pin is seated in the socket, gently push the tube down to fully seat it in the socket. You can wiggle the tube from side to side or front to back **slightly** (less than 1/8" away from straight at the top) if necessary. Do not move the tube further than this - that can damage it. The tube should move approximately 1/8" down into the socket. The pins do not go all the way into the socket - as shown in the following figure, a portion of the pins remains exposed. The tubes are interchangeable - there's no specific order, but it is most convenient to install them from left to right (or right to left, if you're left-handed).

Once installed, you can tilt the tubes slightly (as described above) if any appear tilted compared with each other and the copper rods.

Figure 2–4 Tubes installed in sockets

Once you have inserted all six tubes, we recommend you perform a segment test as shown in Section 9.3 to verify that all of your tubes are working properly with all segments lighting as expected, no tubes substantially brighter or dimmer than the others, and so on. If you discover any problems, try exchanging tubes between sockets. If the problem stays with the tube, you have a bad tube and should contact the seller. If the problem stays with the socket, there may be a problem with the clock and you should refer to Section 9.4 for assistance.

2.2.1 Cleaning the tubes

Once you have a set of 6 matching B-7971 tubes, all in working condition, you can proceed to clean the tubes, if desired, to remove decades of accumulated grime.

WARNING: Make sure that power to the clock has been disconnected before touching any of the circuitry or tubes.

Caution: Do not attempt to clean the tubes "in place" in the clock - instead remove them one at a time for cleaning. This provides you with a larger work area while also preventing water from coming into contact with other clock components. It also reduces the possibility of multiple tubes rolling away and breaking.

We have found that removing a tube and carefully blotting it with a damp paper towel will remove most accumulated grime. Be careful when cleaning the back of the tube, as it is easy to wipe off the factory print with the brand, date code, etc. Some tubes sold as surplus in the 1970's

may have price stickers on the top which are somewhat harder to remove. Patience and gentleness are key here.

There is normally no need to attempt to clean the underside of the tubes where the pins are located.

Once each tube is cleaned and dry, re-install it in the clock. You may want to use cotton gloves to avoid getting fingerprints all over your newly cleaned tubes.

2.3 Installing the cover

Examine the bottom edge of the acrylic cover to make sure the small clear plastic bumpers are in position at each corner. If any have become dislodged, stick them back on in the appropriate location(s).

Position the clock in the location you selected for it. Be sure to leave enough clearance for the power cord to enter on the back left as well as space on the back right to access the control knob.

Place the acrylic cover on top of the clock. You may want to use cotton gloves to avoid getting fingerprints on the cover.

2.4 Connecting power and starting the clock

Unpack the clock AC adapter (the one with the round connector on the end of the cable). Plug the round connector into the back left opening on the clock and plug the adapter into a wall outlet.

Figure 2–5 Power connector location

The clock should light up and display the following (in order):

MODSIX
V09-18 (these numbers may vary)
RF-LNK
HH:MM:SS (time) with underlines
Day of week
Month / day
Year

At this point, the clock should be cycling between displaying the time and (once a minute) the other information.

If any tubes are not lit or the colons in HH:MM:SS are not lit, unplug the clock, remove the cover and check your installation of the tubes.

WARNING: Do not operate the clock without the cover in place - hazardous voltages are present at some locations on the circuit boards when the clock is operating.

Note: You may find the power-on segment test (Section 9.3) useful for troubleshooting.

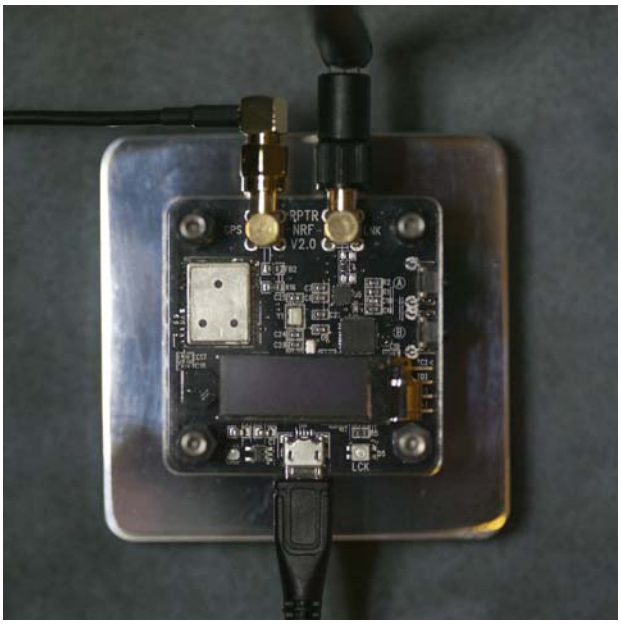
2.5 The RPTR-OLED (Optional)

If this option was ordered, unpack the RPTR-OLED and its two antennas and determine where you want to locate it. The RPTR-OLED contains the environmental sensors for the clock, so you will want to locate it away from any sources of temperature changes such as windows, heaters, and so forth. The RPTR-OLED will operate over distances up to 100 feet, depending on the levels of radio interference in your area. The clock and RPTR-OLED are normally already paired with each other. If you change the radio channel or baud rate (see menu options LNKMNU / RFCHAN and LNKMNU / RFBAUD, respectively) you will need to re-pair the clock and RPTR-OLED. Refer to Section 4.1 for additional information on the pairing process.

Note: While we describe the RPTR-OLED as "optional", many features of the clock require it. For example, GPS synchronization, metrology (temperature / humidity / barometric pressure), and the random word function all require a RPTR-OLED. Therefore we expect that most users will have ordered this option.

2.5.1 Connecting power and starting the RPTR-OLED

Figure 2–6 RPTR-OLED top view



Determine an appropriate location for the RPTR-OLED. The power cord is approximately 6 feet long and the GPS antenna cable is approximately 10 feet long. During the initial setup you will want to have the RPTR-OLED somewhere you can easily observe its display to ensure proper start-up.

After you have the RPTR-OLED up and running, you can relocate it anywhere that is convenient for you.

Unpack the radio antenna (approximately 6" long) and screw it onto the connector labeled LNK on the RPTR-OLED. It is not necessary to tighten it more than finger tight. Once the radio antenna is attached to the RPTR-OLED, use the swivel connector on the antenna to position the antenna pointing straight up. The antenna pivots up to 90 degrees, but normally the best results will be obtained when the antenna is pointing straight up.

Similarly, unpack the GPS antenna. The GPS antenna needs to be able to "see" the GPS satellites, so it should be located near a window. Since the satellites move around in the sky you don't need to point the GPS antenna in any particular direction. The GPS antenna should be positioned horizontally (flat) with the shiny metal side facing down. The base of the GPS antenna has a small magnet that will stick to any ferrous surface. The GPS antenna is not waterproof; do not put it outside. Screw the connector of the GPS antenna onto the connector labeled GPS on the RPTR-OLED. Again, it only needs to be finger tight.

Note: The two antenna connectors are not interchangeable. The radio antenna must be connected to the connector labeled LNK and the GPS antenna to the connector labeled GPS.

Unpack the AC adapter for the RPTR-OLED and plug the end of the cord into the matching connector on the side of the RPTR-OLED. Plug the other end into a wall socket.

Caution: The power connector on the RPTR-OLED is rather delicate (as are all micro USB connectors). Ensure you have the end of the cord in the correct orientation when plugging it into the RPTR-OLED.

When plugged in, the RPTR-OLED will display its firmware version and other information on the white OLED display on the top of the RPTR-OLED, near the power connector. After the unit passes its self-tests, it will announce itself to the clock and begin searching for satellites. The messages sent to the clock convey information about the RPTR-OLED, which the clock will then display. The following is a list of typical display items in order.

RPTR
NRF 47
MET+++
LEXCON
STNDRD
23016
WORDS

This example shows RPTR-OLED firmware V4.7, installed temperature, barometric pressure and relative humidity sensors, and a lexicon (random word dictionary) named STNDRD which contains 23,016 factory-installed words.

Note: See the separate document titled *MOD-SIX Nixie Clock System Updating Instructions* for information on installing user-provided lexicons.

The LED on the RPTR-OLED may flash at intervals to convey additional information about the RPTR-OLED's status. The operation of the LED as well as other RPTR-OLED functions is described in detail in Chapter 4.

Once the RPTR-OLED receives a good GPS signal, it will pass the time and environmental data to the clock. If this results in the clock updating its internal date and / or time, the clock will show this by displaying a "SYNCED" message. Note that if you were watching the RPTR-OLED you may have missed this. The underlines on the tubes will also turn off, indicating that the clock is locked to the satellite time. The environmental data will also be displayed as part of the minute cycle, either before or after the date displays (refer to SYSMNU / DSPORD for additional information).

Note: The barometric trend indicator (rising / constant / falling pressure) requires the RPTR-OLED to have been operating for at least 3 hours in order to collect baseline data.

2.6 The PIR sensor (Optional)

The optional PIR (passive infrared) sensor allows the clock to turn off the display by a slow fade to off after a period of time where no motion has been detected nearby. The delay and the sensitivity are both adjustable to suit your particular environment.

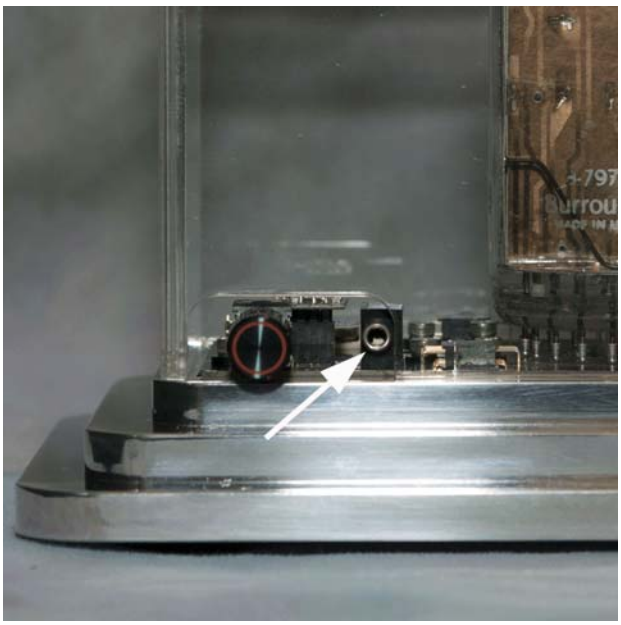
The sensor works on the same principle as a burglar alarm motion sensor - it detects changes in heat patterns in the surrounding area. For best results, the sensor should be located in an area without drafts from non-human sources such as windows and radiators. The sensor has a relatively wide angle of view (110 degrees horizontal x 70 degrees vertical) and up to a 20-foot range. You may need to experiment with the location and orientation of the sensor for best results in your room.

Figure 2–7 PIR sensor

To install the PIR sensor, disconnect power from the clock and plug the sensor's cable into the connector on the clock.

Caution: Always disconnect power from the clock before plugging or unplugging the sensor's cable from the clock. Failure to observe this precaution may damage the clock, the sensor, or both.

Figure 2–8 PIR sensor connector on clock



After plugging the sensor's cable into the clock, re-connect power to the clock and enter the setup menu. Set the TMRMNU / PIR MD option to ON to enable the PIR sensor. Select the "display off" delay using the TMRMNU / PIR TM option. 15 minutes is likely a reasonable starting point - you can adjust the delay to a shorter or longer interval later if needed. The shortest delays (15 and 30 seconds) are mostly useful for testing the PIR function. Operating the clock with a delay that short will likely be annoying as the display rapidly cycles on and off.

You can use the LDRTST menu option to verify operation of the PIR sensor. The left-hand colon lamps will illuminate when the PIR sensor detects motion. Additionally, you can configure the CPU LED to flash when motion is detected by setting SYSMNU / LED MD to PIRTST. For most users, simply having the display turn off and on is sufficient indication that the PIR sensor is operating properly.

Notes: The PIR sensor only turns off the display if it was already on. If the display was off for some other reason, such as being turned off by the timer or by the user, the PIR sensor will *not* turn the display on.

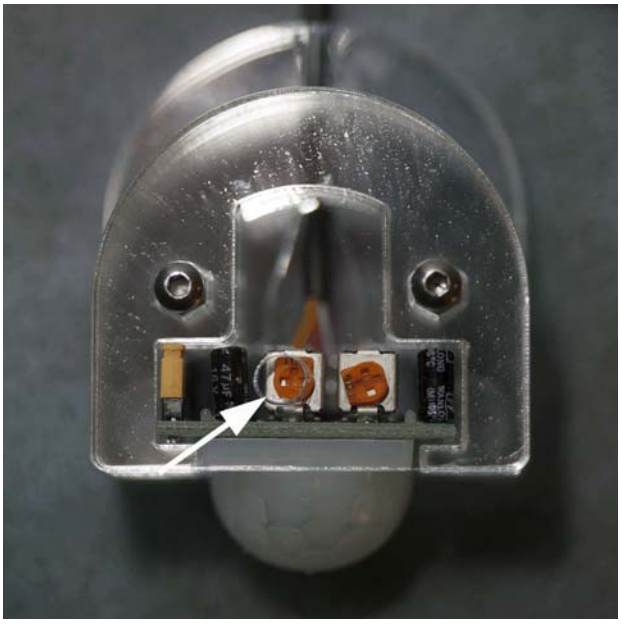
The power supply indicators and the CPU LED will continue to operate as usual when the display is off.

The PIR sensor is shipped with a default sensitivity value that will work for the majority of users. The control shown in the figure below may be used to adjust the sensitivity if desired. Using a small screwdriver inserted through the hole in the clear plastic cover, gently turn the

adjusting knob clockwise to increase the sensitivity or counterclockwise to decrease the sensitivity.

Note: The other adjusting knob is not used in this application and is covered by the clear plastic cover.

Figure 2–9 PIR sensitivity adjustment



2.7 A word about options

The clock comes preset with generic options. See the detailed information on setup options later in this document. There are many, many possible settings that may seem confusing at first. Feel free to read through the documentation and experiment.

2.8 Important Notes

2.8.1 High voltages and general safety

The clock is powered by two approved "wall wart" power supplies, one for the main clock and the other for the RPTR-OLED. These produce perfectly safe low voltages. Inside the clock, there are a number of places where high voltages are exposed.

WARNING: This clock is NOT a toy - please keep the provided clear acrylic cover in place at all times when the clock is operating. It also does a good job of keeping dust out and protecting the expensive tubes.

The RPTR-OLED runs on 5 volts and is electrically quite safe. Therefore, there is a clear acrylic top plate on it to keep the dust off, but if you have inquisitive children, pets, etc. it would be a good idea to put it somewhere out of reach, as it does not get along with (for example) silverware stuck into it, dog drool, and so forth.

The supplied AC adapters are universal and will work internationally as well as in the United States. If you are installing the clock outside the US, you will usually need adapters to convert the plugs to match your wall sockets.

Do not use AC adapters other than the ones provided with the clock.

2.8.2 Intermittent GPS reception

If you are in an area with poor GPS reception you may want to disable the "lost GPS signal" indication (normally underlines on all of the tubes) in the configuration options. The clock keeps excellent time even without a GPS signal, and as long as the RPTR-OLED can get a signal once a day or so, the clock will be perfectly happy.

2.8.3 Buzzing noises

In a very quiet room, you may notice a high-pitched buzzing coming from the clock. This is normal and is caused by the tubes vibrating as they are switched on and off thousands of times a second. Adjusting the display brightness (using the BRIGHT and DIM menu options) will normally clear this up - even a change of a single digit can make the noise disappear or become much less obvious. For extreme cases, you can adjust the SYSMNU / PWMVAL setting, which changes the speed at which the clock updates the tubes. Changing the SYSMNU / PWMVAL setting may alter the apparent brightness of the display, and you may wish to adjust the BRIGHT and / or DIM settings accordingly.

2.8.4 "Cathode poisoning"

Don’t worry, "cathode poisoning" isn’t dangerous to you or any other form of life. It is a technical term referring to a particular type of damage inside the tubes. "Cathode poisoning" is when not all of each segment lights fully. The ends of the segment could light and not the middle, or vice versa. Or the segment could flicker. This can begin to damage the tubes (expensive!) if it persists for an extended period. Be sure to set the BRIGHT and DIM settings high enough that the segments light completely, or to 0 so that the display is completely off.

Note: The brief period where the display flickers on its way to fully off (when DIM 0 is selected) will not cause problems.

2.9 General care and maintenance

The acrylic covers on the clock, RPTR-OLED, and TimeLink receiver may be cleaned if necessary. Normally all that will be needed is a light dusting with a dry Swiffer® cloth. Deeper cleaning can be done with a slightly damp soft cloth. Use water only, not any cleaning products. Never use an abrasive cleaner on any clock component. To remove scratches in the acrylic cover or for extra-deep cleaning, NOVUS® brand plastic polish is recommended.

The metal baseplates of the clock, RPTR-OLED, and TimeLink receiver may also be cleaned with a dry Swiffer® cloth if needed.

Make sure that all dust or other particles have been removed from the component you are polishing (via a light dusting) before polishing the component. Trapped particles can damage the finish if not removed before final polishing.

Never clean any components other than the baseplates and acrylic covers of the clock, RPTR-OLED and TimeLink receiver.

Cautions: The baseplates, particularly the polished versions, can be easily scratched if proper cleaning procedures are not followed.

Ensure no liquids or other contaminants come near the RPTR-OLED circuit board as the environmental sensors on it can easily become contaminated and produce incorrect readings.

Like all electronic devices, the clock can be damaged by static electricity. When installing the clock or any accessory, or changing settings on them, always touch the aluminum baseplate first to discharge any static.

The clock and keyfob use batteries to keep the time going and remember the other settings in the event of a power failure. These batteries should last longer than 4 years under normal operation and are a common CR2032 type which your local drugstore, camera store, etc. will have in stock. You may also order the battery from online retailers such as Amazon®.

Replacement tubes are occasionally available on eBay® (currently around US $100 each). The expense and rarity of these tubes add to the uniqueness of the clock, but also means you should be extra careful to not damage them, either when installing them or during normal operation. A stray softball coming through the window and knocking the acrylic cover off the top of the clock will likely ruin your entire month.

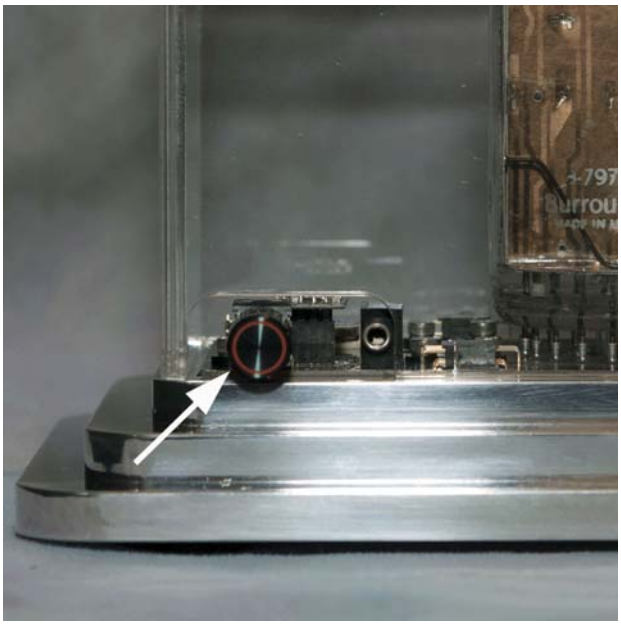
3 Configuration options

The clock contains a large number of settings which allow it to be configured for your particular tastes. The following sections describe the menus and how to change the options. There are many, many possible settings which may seem confusing at first. Feel free to read through the information and experiment - you can easily get back to the standard settings at any time.

3.1 The control knob

The clock's user interface is provided by an easy-to-use rotary encoder knob located on the right rear of the clock. The knob can be rotated clockwise (CW), or counterclockwise (CCW). It also has a pushbutton that can be pressed briefly and released (a "short press") or pressed and held for longer than 3 seconds (a "long press").

Figure 3–1 Control knob location



While in normal time display mode, if the knob is pressed for more than three seconds, the clock will enter configuration mode. Release the knob and rotate it to select the option to be modified. When the name of the option to be changed is displayed, a short press will then allow modification of the option by rotating the knob. Detailed explanations for each of the configuration options are provided later in this chapter.

If the clock is left in configuration mode displaying an option name, it will time out after 90 seconds of inactivity, save any changes, and exit configuration mode. This is to prevent accidental button presses from putting the clock into configuration mode unexpectedly. This timeout does not occur when displaying an option value (as opposed to the option name), as it is assumed that the multiple operations necessary to get that far into the menu were intentional.

Note: Most options will not take effect until the configuration mode is exited.

Options are grouped by related functions. Some options are organized within sub-menus. You may return to the main menu by selecting the RETURN option from within these sub-menus. Configuration mode can be exited by selecting EXIT from the main menu, or at any time by a long press from within most menus.

3.2 Quick-set mode

The clock has a "quick-set mode" to allow you to change a number of settings without needing to enter the full menus.

The first function allows you to override the day / night timer or force the display on, off, or controlled by the optional PIR, depending on the setting of the TMRMNU / QWKSET option.

QWKSET	Knob function
OFF	No function
TIMER	Turns TMRMNU / TMR MD ON with CW, OFF with CCW † ‡
DISP	Display on with CW, cycles between display off and display controlled by PIR with CCW ‡

†This overrides the day / night timer (if enabled) until the next time the timer would turn the display on or off.

‡This assumes that SYSMNU / ENCDIR is set to the default of CW. If that option is set to CCW, the rotation directions in this table are reversed.

The second function allows you to adjust the time. This is only needed if the clock is not receiving a GPS time signal from the optional RPTR-OLED for some reason. A short press on the knob will produce an underline on the hour's tubes. Rotate the knob to set the hours, then press the knob again to advance the underline to the minutes setting. Rotate the knob to set the minutes, then press again to advance to seconds. Rotate the knob to set the seconds and press again to exit.

Note: If the clock receives a GPS time signal from the optional RPTR-OLED, the clock will display the message "SYNCED" and change the time accordingly, overriding the manual time settings.

3.3 The main menu

The main menu is entered by a long press of the knob. The clock will adjust its display brightness to ensure that you can see the menus (it would be hard to adjust the brightness if you couldn't see the menu to set it!).

3.3.1 TIME

This item sets the time when no GPS time signal is available from the optional RPTR-OLED. See the previous section for details. RPTR-OLED is used, this option is ignored and the information from the GPS signal is used instead.

3.3.2 FONT

This item selects the font used when the time is displayed. Examples of all of the fonts are available in Chapter 7 as well as via the clock's FNTCAT option.

3.3.3 DATE

This item sets the day of the month (1-31) when no GPS time signal is available from the optional RPTR-OLED.

3.3.4 MONTH

This item sets the month (JAN-DEC) when no GPS time signal is available from the optional RPTR-OLED.

3.3.5 YEAR

This item sets the year when no GPS time signal is available from the optional RPTR-OLED. The allowable values are 2000 through 2099.

3.3.6 DIM

This item sets the brightness of the clock when operating in "dim" mode where ambient light is below the level set by the LVLSET item. Allowable values are 0 (completely off) and 1 (dimmest) to 100 (brightest). Please note the caution regarding tube damage in Section 2.8.4, and set the minimum brightness accordingly. If you want the clock display to turn off when the room is dark, simply set this item to 0.

Note: The "power on" neon lamp and LEDs on the left side of the clock will always remain lit to show that power is still applied to the clock.

3.3.7 BRIGHT

This item sets the brightness of the clock when ambient lighting is above the level set by the LVLSET item. The allowable values are 0 to 100, as for the previous item.

3.3.8 LVLSET

This sets the ambient light level that switches between the DIM and BRIGHT display levels. You can use the LDRTST item to determine the best setting for your installation. Set the value to approximately the difference between the bright and dim readings from LDRTST. Adjust it if you notice the clock repeatedly switching between bright and dim due to minor changes in the ambient light level.

Note: The brightness changes slowly over a period of several seconds in order to reduce the distraction when the change happens.

3.3.9 DOT MD

This item determines the behavior of the colon separator neon lamps. When ON, they are always on when the time is displayed. When set to BLINK they will cycle on and off in unison. When set to ALT they will cycle between the top and bottom lamps. When set to RAILRD they will cycle between top left / bottom right and bottom left / top right. When OFF, they will always be off. For the options with cycling, the interval is 2 seconds - 1 second in the 1st state, then 1 second in the 2nd state.

3.3.10 AM/PM

This setting determines the behavior of the AM/PM indicator neon lamp to the left of the hours. When OFF, it is always off. When ON, it will be dark for AM and lit for PM. If set to FLIP, it will be lit for AM and dark for PM.

3.3.11 XFADE

This item controls the speed at which numbers and letters fade from one to the next. Allowed values are 1 to 32, with larger numbers increasing the time the fade operation takes. A value of 1 indicates 1/16 of a second, while a value of 32 indicates 2 seconds.

3.3.12 DATEMD

This setting determines if the date should be displayed and how often. It can be set to a variety of values. OFF disables the date display, 30 SEC displays the date twice per minute, 1 MIN through 15 MIN represent the number of minutes between date displays at the top of the minute, and 1↓MIN through 15↓MIN represent the number of minutes between date displays at the bottom of the minute.

3.3.13 DATFMT

This setting controls the display order of the day of the month and the month. When set to MMM DD the date is displayed as (for example) "DEC 11" and if it is set to DD MMM the date is displayed as "11 DEC".

3.3.14 DATDLY

This controls the amount of time each item of the date display is shown on the clock. The value ranges from 1-64 and represents the 16ths of a second for each item. For example, a value of 16 would show each item for exactly one second, a value of 40 would show each for 2.5 seconds, and so on.

3.3.15 DATSCR

There are three ways the date messages can appear. They can fade in and out as the time does, scroll on and off, or fade in and scroll off. If this option is set to FADE they will fade in and out, if set to SCROLL they will scroll in and out, and if set to FDSCRL they will fade in and scroll out.

3.3.16 YEAR D

This setting controls whether the year is displayed as part of the date messages. Valid settings are OFF and ON.

3.3.17 DAY D

This setting controls whether day name is displayed as part of the date messages. Valid settings are OFF and ON.

3.3.18 12/24

The clock is capable of displaying time in both 12-hour (normal) and 24-hour (military) time. In 12-hour mode the clock displays time from 12:00:00 through 11:59:59 and then repeats, while in 24-hour mode the clock displays time from 00:00:00 through 23:59:59. The allowed values are 12 HR and 24 HR.

3.3.19 LZ SUP

This setting controls whether the leading zero in the hours (for example, the "0" in 09:45:12) is displayed, or whether it should be suppressed (replaced with a blank). It can be set to OFF (show the zero) or ON (hide it).

3.3.20 LDRTST

This function displays the light sensor reading. It will report a reading between 0 and 100 depending on the level of ambient light in the room (0 is darkest, 100 is brightest). This is useful for selecting an optimal value for the LVLSET option.

Note: The light sensor is the clear component located to the right of the battery.

If the optional PIR sensor is installed, the colon between the hours and minutes tubes will illuminate to indicate that the PIR has detected activity. This is useful for determining the optimal location for the PIR sensor.

3.3.21 FNTCAT

This function will display the characters used in each of the clock's numeric fonts. Turn the knob to select a font name and then press to display it. Rotate the knob to cycle between displaying digits 1-6 and 5-0. Press briefly to return to the font catalog. A long press, while a font name is being displayed, will exit the menus completely. A long press while a font sample is being displayed will display SETFNT and then CONFIRM. A long press of the knob will display DONE and configure the clock to use the selected font. Rotating the knob in either direction will display ABORT, the font will remain unchanged, and the clock will return to the FNTCAT menu.

Note: If the SYSMNU / DSPFNT option is not set to TIME F any change made here will only affect the font used to display the time, not the font used for other messages.

3.3.22 TUBETM

With this item, you can see the number of hours the tubes have been lit. When the tubes are turned off, either by a DIM value of 0, timer setting, or via the PIR sensor, the tube timer does not increment. You can reset the timer by a long press of the knob and then updating each of the digits in turn by rotating the knob and then pressing it briefly. Exit with a long press of the knob. After saving the new timer value, the clock will report DONE.

Note: This item only displays the time the tubes are lit in this clock, not in their former lives as stock quotation tickers.

3.3.23 GPSMNU

This setting enters the GPS configuration sub-menu.

3.3.24 SYSMNU

This function enters the system sub-menu.

3.3.25 TMRMNU

This setting enters the timer sub-menu.

3.3.26 DSTMNU

This function enters the Daylight Saving Time sub-menu.

3.3.27 LNKMNU

This function enters the RF Link (radio) sub-menu.

3.3.28 DIMMNU

This function enters the dimmed display sub-menu.

3.3.29 METMNU

This function enters the metrology (sensor) sub-menu.

3.3.30 WRDMNU

This function enters the random word generator sub-menu.

3.3.31 PROFLE

This function allows you to save, restore, or initialize the clock's configuration. The options are CANCEL (exit), BACKUP (save the settings), RESTOR (restore the settings), and FACTRY (use the settings the clock was built with). Refer to Section 3.12 for more information.

3.3.32 EXIT

Selecting this item stores any changes made to the configuration and returns the clock to its normal display mode. A long press will also save and exit.

3.4 The GPS sub-menu

This sub-menu controls various settings related to the optional RPTR-OLED and time synchronization.

3.4.1 GPS MD

This function tells the clock if an optional RPTR-OLED is installed. OFF means that there is no RPTR-OLED and RF-LNK configures the clock to work with the optional RPTR-OLED (see Chapter 4 for details on the RPTR-OLED).

3.4.2 TMZONE

This item configures your time zone (offset in hours and minutes from UTC / GMT). For example, Eastern Standard Time (US) is GMT -5:00. Australian Central Western Time is GMT +8:45. Rotate the knob to select + or -, then press to select the offset hours. Rotate the knob to select values between 0 and 23, then press again to select the offset minutes. Rotate the knob to select values between 00 and 59. Press again to exit.

3.4.3 TWK16S

If you have some other clocks which are always off by a certain amount and you've become used to it, you can use this option to "tweak" the clock's displayed time between 6 seconds slow to 6 seconds fast in increments of 1/16th of a second. Allowable values are -96 (6 seconds slow) to 96 (6 seconds fast).

Note: There is also an adjustment on the RPTR-OLED. If the value on the RPTR-OLED is changed, the effect is cumulative with the value set on the clock.

3.4.4 ULCK I

As the GPS satellites are constantly moving overhead, there may be periods of time when the GPS receiver in the RPTR-OLED cannot lock onto the GPS signal. The clock can let you know this has happened by displaying the unlocked indicator. A variety of different indicator types can be shown on the underline segments of the tubes. Rotate the knob to select the style most appealing to you.

Note: If your RPTR-OLED is located in an area with poor GPS reception, the cycling of the unlocked indicator on the clock may become annoying. You can set it to have all underlines off (no indicator) and optionally use the SYSMNU / LED MD option to display the unlocked indication.

3.4.5 ULCKTM

This setting controls how long the clock will wait after the loss of the GPS signal before activating the unlocked indicator. It can be set to values between 1 and 240 seconds.

3.4.6 SNCMSG

This option controls whether the clock will display SYNCED messages when it updates its time from the GPS signal.

Note: You may also disable all status messages by setting the SYSMNU / MSGS option to OFF.

3.4.7 RETURN

Return to the main menu.

3.5 The system sub-menu

The system sub-menu contains configurations options which are generally not changed after the clock has been set up. Most of the commonly-used items are located in the top-level menus.

3.5.1 QWKSEL

This item controls the response to a brief press on the control knob. TM SET allows quick setting of the time as shown in Section 3.2. WORDS will display one or more random words (optional RPTR-OLED required). METRPT displays the various sensors (temperature, humidity, etc.) DATE displays the date info, and NONE sets the knob to have no function.

Note: See TMRMNU / QWKSET for configuring the knob's response to rotation.

3.5.2 UI TMR

This setting controls the amount of time the display remains illuminated when the clock is awakened by rotation of the knob or a press of a button on the optional keyfob. It can be set to values between 1 and 240 seconds.

3.5.3 DSPFNT

This item selects the numeric font used when non-time data (such as the date, temperature, etc.) is displayed. Examples of all of the fonts are available in Chapter 7 as well as via the clock's FNTCAT option. The default, TIME F, is to use whichever font is selected as the time font.

Note: Letters and punctuation are always displayed in the standard font - this option only controls numbers displayed during other (non-time) messages.

3.5.4 SEGTST

This function allows you to test all of the display elements for proper operation. Rotating the knob will cycle each individual tube element on and off in order, then will cycle through the neon AM/PM and colon lamps. Next, it will turn all elements and neon lamps on at once, then all off. Briefly press the knob to exit this function.

Note: The "power on" neon lamp and LEDs on the left side of the clock will always remain lit to show that power is still applied to the clock.

3.5.5 LED MD

This option controls the behavior of the green LED to the left of the battery. There are a wide variety of choices to suit individual tastes. In addition to basic OFF and ON functionality, 1PPS will cause the LED to pulse once per second, SYNC will cause it to pulse whenever the clock synchronizes time with GPS time. RF RCV causes it to pulse whenever a message is received via the RPTR-OLED. PIRTST will cause it to pulse whenever the optional PIR sensor is triggered. LOCKED will light the LED when the clock is synchronized to GPS time via the optional RPTR-OLED, while NOLOCK will light it when the clock is **not** synchronized.

Note: The SYNC setting does not cause the clock to pulse the LED each time that a time message is received, but only when the clock updates its time because it disagrees with the time received via GPS. The SYNC setting may be desirable if you have MSGS turned off (see below) and you would still like an indication when the clock updates its time.

3.5.6 SECNDS

This setting configures the seconds display in BRIGHT mode. It can be set to ON, SPIN*_, SPIN_*, SPIN**, or OFF. The SPIN modes generate a spinner on either the 10's of seconds, 1's of seconds, or both.

Notes: Due to the number of display segments available in the tubes, the spinner is not an actual "sweep hand".

For the corresponding function when the clock is dimmed, refer to DIMMNU.

3.5.7 MSGS

This setting controls whether or not status messages such as SYNCED, PING, etc. are displayed on the tubes. It can be set to OFF or ON.

3.5.8 SCRLSP

This option selects the speed at which text scrolls across the display. Valid settings are from 1 to 32. Higher values select slower scroll speeds. It interacts with SCRLXF. A value of 1 indicates 1/16 of a second, while a value of 32 indicates 2 seconds.

3.5.9 SCRLXF

This option sets the length of time the clock crossfades between characters when scrolling text. Valid settings are from 1 to 32, with higher values lengthening the fading effect. It interacts with SCRLSP. A value of 1 indicates 1/16 of a second, while a value of 32 indicates 2 seconds.

3.5.10 DSP 1

This setting controls the number of items displayed during any interval where information other than time is displayed. The display can become "overcrowded" (see Appendix D) if a large number of items are selected. For example, if you have selected to display a random word every 5 minutes, every fifth minute might display the sequence of day name / month / date / year, the current metrology (sensor) data, and the random word. This can be a bit excessive, particularly for people who just want to know what time it is. Setting this option to ON limits the display to a single item type in conjunction with the DSPORD setting. Setting it to OFF allows the display of all configured items.

3.5.11 DSPORD

This option controls the order of displayed items. WMD sets the order to words, metrology, and date. DMW sets the order to date, metrology, and words. In conjunction with the DSP 1 setting DSPORD controls which of the items will be displayed.

3.5.12 PWMVAL

This option sets the frequency which the clock uses to control the dimming of the tubes. The setting is the frequency used, which can be set to one of the following values: 57KHZ, 28KHZ, 14KHZ, 7200HZ, 3600HZ, or 1800HZ.

Lower frequencies will provide greater dimming range, but the frequency may interact with the power supply module or tubes and become audible, depending on the particular tubes in the clock and the range of your hearing. See Section 2.8.3 for more information.

3.5.13 ENCDIR

This setting can be used to reverse the function of the knob's rotation. Setting it to CW causes values to increase when the knob is rotated clockwise while setting it to CCW causes the values to increase when rotated counterclockwise.

3.5.14 RTCAGE

This setting is used to make extremely fine adjustments to the clock's timekeeping when GPS time is not used. You should never have to change this from its default value of 0. The valid settings are -128 to +127.

3.5.15 RETURN

Return to the main menu.

3.6 The timer sub-menu

The timer function allows you to program in times when the tubes are turned off. This can reduce the number of hours the tubes are illuminated to extend their projected lifespan, or simply blank the display when no-one is around to watch it.

Notes: This section just describes the possible settings for each option. For a detailed explanation of their usage, refer to Appendix C.

Brightness levels slowly ramp up and down to target levels, allowing time for the final brightness level to be reached.

If you prefer, you can set DIM to 0, which will cause the tubes to turn off when the room is dark.

3.6.1 TMR MD

This setting enables or disables the timer function.

3.6.2 TM1OFF

This option configures the Timer 1 OFF start time. A short press on the knob will produce an underline on the hour's tubes. Rotate the knob to set the hours, then press the knob again to advance the underline to the minutes setting. Rotate the knob to set the minutes, then press again to advance to seconds. Rotate the knob to set the seconds and press again to exit.

Notes: If you have configured the clock for 12-hour display mode, make sure that you have selected the correct time by checking the AM/PM indicator light when setting the hours.

The "power on" neon lamp and LEDs on the left side of the clock will always remain lit to show that power is still applied to the clock.

3.6.3 TM1 ON

This sets the Timer 1 ON start time. Refer to the previous item for details.

3.6.4 TM2OFF

This sets the Timer 2 OFF start time. Refer TM1OFF for details.

3.6.5 TM2 ON

This sets the Timer 2 ON start time. Refer to TM1OFF for details.

3.6.6 MON - SUN

These options select which timer(s), if any, will be used for each day of the week. They can be set to TMR1 which will use the times set in TM1OFF / TM1 ON, TMR 2 which will use TM2OFF / TM2 ON, TMR1 2 which will use both, NX OFF which will turn the tubes off on that day, NX ON which will turn the tubes on, or TMROFF which performs no special action on that day.

3.6.7 PIR MD

This setting enables or disables the use of the optional PIR (passive infrared) sensor. The PIR sensor is used to detect movement in the room, similar to a burglar alarm motion sensor. Setting this option to ON enables the PIR sensor to turn the clock display off after an interval where no movement has been detected.

Note: If the clock display would have been off for some other reason, such as being turned off by the timer or by the user, the PIR sensor will *not* turn the display on.

Setting this option to OFF disables the PIR sensor, or when the optional sensor is not installed. Used in conjunction with PIR TM. See LDRTST and LED MD for additional PIR information.

3.6.8 PIR TM

This selection controls how long the clock display will be turned on if the PIR detects motion and the PIR MD setting is ON. Valid settings are 15 or 30 seconds; 1, 3, 10, 15 or 30 minutes; 1, 2 or 4 hours. If additional motion is detected by the PIR before this time interval expires, the timer will be reset to the selected value and a new countdown will start.

3.6.9 QWKSET

This option sets the behavior when the knob is turned during normal operation. If it is set to OFF, this function is disabled. If the option is set to TIMER, rotating the knob will alternately turn the TMR MD option ON and OFF. If the option is set to DISP, rotating the knob will alternately turn the display off or on.

Note: See SYSMNU / QWKSEL for configuring the knob's response to brief presses.

3.6.10 RETURN

Return to the main menu.

3.7 The DST sub-menu

This would be so much simpler if governments would stop changing the Daylight Saving Time rules... However, since that is unlikely to happen, the clock allows for every possible rule that might exist, even if you need to set your clock back 37 minutes and 18 seconds in the spring, and ahead in the fall!

3.7.1 DST MD

This setting enables (ON) or disables (OFF) the Daylight Saving Time auto-adjust.

Note: This does not indicate whether DST is currently in effect, but rather if the clock will change time when DST begins or ends.

3.7.2 B TIME

This value sets the time of day when DST begins.

3.7.3 B MNTH

This value sets the month when DST begins.

3.7.4 B NTH

This value sets which week (FIRST, SECOND, etc.) of the month DST begins.

3.7.5 B DAY

This value sets the day of the week when DST begins.

3.7.6 E TIME

This value sets the time of day when DST ends.

3.7.7 E MNTH

This value sets the month when DST ends.

3.7.8 E NTH

This value sets which week (FIRST, SECOND, etc.) of the month DST ends.

3.7.9 E DAY

This value sets the day of the week when DST ends.

3.7.10 OFFSET

This value controls the size of the adjustment when DST is in effect. While normally 1 hour, it can be set to any offset if necessary. Rotate the knob to select + or -, then press to select the offset hours. Rotate the knob to select values between 0 and 23, then press again to select the offset minutes. Rotate the knob to select values between 00 and 59. Press again to exit.

3.7.11 RETURN

Return to the main menu.

3.8 The RF Link (radio) sub-menu

This menu contains options for configuring the radio settings used by the clock.

3.8.1 RFCHAN

This item selects the radio channel used for communication with the RPTR-OLED. For more details, refer to Section 4.1.

3.8.2 RFBAUD

This item selects the speed of radio transmissions when communicating with the RPTR-OLED. For more details, refer to Section 4.1.

3.8.3 FOB MD

This option controls the clock's response to the optional keyfob. Setting it to ON allows full control of the clock by the keyfob, while setting it to VALET prevents the keyfob from changing the clock's configuration settings. A value of OFF causes the clock to ignore the keyfob totally. An example use of the VALET option is when the clock is locked inside a display cabinet and you want to allow someone to turn the clock display off and on with the keyfob, but not let them change any of the clock's menu settings.

3.8.4 ADDR

The ADDR option allows you to assign a unique address to the clock when a number of clocks are operating on the same RF channel. Allowable values are 0 through 7, with a default of 0. This is useful when you are using multiple clocks with a single RPTR-OLED (see Section B.2) but would like to control each clock with a different keyfob. The clock will only respond to a keyfob set to the same address as the clock.

3.8.5 RETURN

Return to the main menu.

3.9 The dimmed display sub-menu

This menu sets display options when the clock is operating in DIM mode. For user convenience, distracting display operations can be suppressed when the clock is in DIM mode (for example, in a bedroom).

3.9.1 DATE

This option controls whether or not the date information will be displayed when the clock is in DIM mode. If ON, the date will display as configured in the main menu. If OFF, the date will not be displayed.

3.9.2 SECNDS

This setting adjusts the behavior of the second's digits in DIM mode. It can be configured to behave the SAME as the SYSMNU / SECNDS setting, or set to any of the other possible values for the SYSMNU / SECNDS setting.

3.9.3 DOT MD

Similar to SECNDS above, it can be set to behave the SAME as SYSMNU / DOT MD or to any of the other choices for SYSMNU / DOT MD.

3.9.4 LED MD

As for DOT MD above, you may set this option the SAME as SYSMNU / LED MD or to any of possible settings for SYSMNU / LED MD.

3.9.5 MET

This setting controls whether or not the metrology sensor data (temperature, etc.) is displayed when the clock is in DIM mode. It can be set to ON or OFF.

3.9.6 WORDS

This setting controls whether or not random words are displayed when the clock is in DIM mode. It can be set to ON or OFF.

3.9.7 RETURN

Return to the main menu.

3.10 The metrology (sensor) sub-menu

Notes: If a clock is not equipped with a sensor (for example, clocks without an optional RPTR-OLED do not have an external temperature sensor), the sensor(s) will be treated as if the corresponding LBL option was set of OFF - in other words, it will never display regardless of the LBL setting for that sensor.

Not all of the optional sensors provide readings for all 3 items (temperature, humidity, and barometric pressure). If a sensor does not provide a reading for an item, display of that item will be skipped.

Offsets to the reported sensor readings can be set on the RPTR-OLED. If an offset on the RPTR-OLED is changed, the effect is cumulative with any offset value set on the clock.

Some of these options are for potential future add-ons. The presence of options in this menu does not indicate that the add-ons are available, nor imply any promise that they will be offered at any point in the future. Such options will be noted as "for future use".

3.10.1 MET MD

This setting determines if the temperature and other sensors should be displayed and how often. It can be set to a variety of values. OFF disables the sensor display, 30 SEC displays the date twice per minute, 1 MIN through 15 MIN represents the number of minutes between sensor displays at the top of the minute, and 1↓MIN through 15↓MIN represents

the number of minutes between sensor displays at the bottom of the minute.

Note: The SYSMNU / DSPFNT and DATDLY menu items also control the font and delay when displaying the temperature.

3.10.2 F/C

This option selects the scale used when displaying temperature. FAHR selects Fahrenheit, while CELS selects Celsius.

3.10.3 HG/MB

This option selects the scale used when displaying humidity. IN HG selects inches of mercury, while MILBAR selects millibars.

3.10.4 BTREND

This option controls the display of barometric trends. OFF disables trend display, TEXT displays the trend as a word (like "RISING") on a separate display line, while COMPCT displays a single concise symbol at the right of the barometric pressure display line.

3.10.5 S1 LBL

The clock can display data from up to four remote sensors. Sensor 1 is normally the sensor on the RPTR-OLED while sensors 2 through 4 are for additional sensor units (**for future use**).

This option controls whether the data from sensor 1 is displayed and how it is labeled. OFF disables the display, while the other settings (BLANK, A, B, C, D, R, I, O and *) will enable the display using the indicated label.

3.10.6 T1 CAL

This option allows adjustment of the temperature reported by the temperature sensor. It can be adjusted from -20 degrees to 20 degrees. The calibration is expressed in display units, so a value of 1 will increase the display by one degree Fahrenheit if METMNU / F/C is set to FAHR or by one degree Celsius if set to CELS.

3.10.7 H1 CAL

With this option calibrates the humidity sensor on remote sensor A. The adjustment range is -20 to +20 percent. Note that humidity can vary greatly over short distances, even outside in open spaces. Also, the response time differs on various types of humidity sensors. Thus, attempting to fine-tune the calibration of the humidity sensor is likely to be non-productive.

3.10.8 B1 CAL

This option fine-tunes the reported barometric pressure. The adjustment range is -125 to +125. This value is always in millibars regardless of the setting of METMNU / HG/MB.

Note: One millibar is approximately equivalent to 0.03 inches of mercury.

3.10.9 S2 LBL

This option (and the corresponding T2 CAL, H2 CAL, and B2 CAL) operates as described above for sensor 1.

3.10.10 S3 LBL

This option (and the corresponding T3 CAL, H3 CAL, and T3 CAL) operates as described above for sensor 1.

3.10.11 S4 LBL

This option (and the corresponding T4 CAL, H4 CAL, and B4 CAL) operates as described above for sensor 1.

3.10.12 CLKSTA

This option controls the sensor number used to display the clock's internal temperature sensor.

Notes: This sensor is located inside one of the clock's integrated circuits. Due to normal heating of the electronics as well as operating inside the acrylic case, the temperature reported by this sensor will be higher than the room temperature. Thus, it is probably of interest to only a small subset of users and is set to OFF by default.

Users should avoid conflicting numbering between the internal temperature sensor and any installed remote sensors in order to avoid inconsistent displays. For example, if the optional RPTR-OLED is installed, it will usually appear as sensor 1 and the internal sensor should be assigned to sensor 2, 3, or 4 in this case.

3.10.13 H SUFF

With this option, you can control the suffix used for display of humidity. You can choose from RH, H, % or %H.

Note: The percent symbol is somewhat unusual looking due to limitations imposed by the number of segments in the tube. There are two different styles to accommodate user preferences.

3.10.14 HEAR D

Normally the RPTR-OLED will handle receiving data from additional sensors and relay it to the clock. The HEAR D (hear directly) option, when set to ON, configures the clock to receive data directly from the remote sensors. Depending on the locations of the clock, RPTR-OLED, and any remote sensors ON or OFF may produce different results. Experiment to determine which setting is best for your particular installation. **For future use.**

3.10.15 DSPDLY

This setting controls the amount of time each item of sensor data is shown on the clock. The value ranges from 1-64 and represents the 16ths of a second each item will be shown. For example, a value of 16 would show each item for exactly one second, a value of 40 would show each for 2.5 seconds, and so on.

3.10.16 RETURN

Return to the main menu.

3.11 The random word sub-menu

Note: The dictionaries of random words are stored in the optional RPTR-OLED. If you do not have a RPTR-OLED as part of your clock system, the clock will display NOWRDS instead of a random word if the random word feature is enabled. Similarly, NOWRDS will be displayed if the RPTR-OLED is present but not communicating with the clock for some reason. The clock buffers a small set of words to handle temporary loss of communication with the RPTR-OLED.

3.11.1 WRD MD

This setting determines if words should be displayed and how often. It can be set to a variety of values. OFF disables word display, 30 SEC displays a word twice per minute, 1 MIN through 15 MIN represent the number of minutes between word displays at the top of the minute, and 1↓MIN through 15↓MIN represent the number of minutes between word displays at the bottom of the minute.

3.11.2 NWORDS

This option selects how many words will be displayed at a time. It can be set to a value between 1 and 5.

3.11.3 LEXICN

This option controls whether words are selected from both the 6-letter and 4-letter dictionaries (ALL), 6-letter only (6 LTRS), or 4-letter only (4 LTRS).

3.11.4 DIRTY

This option controls the display of "dirty words". It can be set to OFF, ON, or CENSOR. CENSOR will replace one or more letters with the * character.

3.11.5 EFFECT

This setting selects how words appear on the clock. It can be set to NONE (no special effect), L-FILL (words appear from left to right), R-FILL (right to left), RNDLET (letters appear in random order), RNDSEG (segments appear in random order), RANDOM (one of the above methods is chosen at random, or RNDRND. RNDRND only has effect when NWORDS is set to a value greater than 1. In that case, if RANDOM is chosen, the same method will be used for all words in the sequence. RNDRND will use a different random method for each word.

3.11.6 LETDLY

This option determines the delay between letters in 16ths of a second per letter. For example, a value of 16 would pause for exactly one second between letters, a value of 40 would pause for 2.5 seconds, and so on. It can be set to a number between 1 and 128.

3.11.7 SEGDLY

This option behaves similarly to LETDLY, but controls the delay between segments appearing when EFFECT is set to RNDSEG.

3.11.8 WRDDLY

This setting operates similarly to LETDLY, but controls the delay between words when NWORDS is set to a value greater than 1.

3.11.9 BKENDS

The bookends setting controls what is displayed in the 1st and 6th characters of the display when a 4-letter word is displayed. OFF will leave those positions blank, - - displays dashes and * * displays asterisks.

3.11.10 RETURN

Return to the main menu.

3.12 Restoring default settings

While you are becoming familiar with the clock's operation and features, we suggest not using the BACKUP option (your settings are still remembered by the clock). If you get stuck with some odd options, you can use the RESTOR or FACTRY options to get things back to the way the clock was shipped. Once you're happy with your customizations, you can use the BACKUP option to save them so that you can restore them at any future time. That's handy if, for example, you want to show off the various features to someone but then want to get everything back to the way you like it.

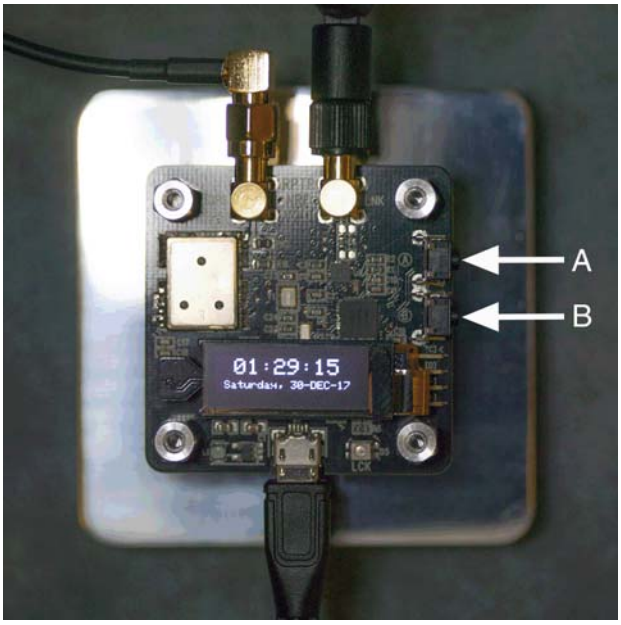
Note: The default settings are listed in Appendix A.

4 The RPTR-OLED (Optional)

The optional RPTR-OLED operates as a wireless repeater of GPS time information, transmitting the time to the clock and / or TimeLink receiver(s) once per second. Additionally, the RPTR-OLED measures the ambient environment (temperature and optionally humidity and / or barometric pressure) and transmits this information to the clock (and optional TimeLink receiver) every 15 seconds. The RPTR-OLED is also the source of random words for the clock's word display function (see WRDMNU). The ability to separate the GPS antenna and RPTR-OLED from the clock allows more flexibility when locating the clock in your home or office.

The clock, TimeLink receiver(s) and RPTR-OLED are normally already paired to each other. If you change the radio channel or baud rate (see menu options LNKMNU / RFCHAN and LNKMNU / RFBAUD, respectively) you will need to re-pair the clock and RPTR-OLED.

Figure 4–1 RPTR-OLED top view showing button locations



During normal operation, the LED on the RPTR-OLED will pulse to display various status indications. If the LED is distracting, you can either disable it or set it to be on solid via the RPTR-OLED's configuration menu.

The following table shows the LED meanings in normal (pulse) mode:

LED	Description
Blink Green	Time packet sent
Blink Red	Packet from remote sensor (**for future use**) or keyfob received
Blink Yellow	Non-time packet sent
Solid magenta	Bootloader mode †
Solid yellow	Firmware updating †

†Bootloader mode and firmware updating are covered in the separate document titled *MOD-SIX Nixie Clock System Updating Instructions*

Once the RPTR-OLED has acquired GPS lock, a brief press of either the A or B buttons will cycle through 3 informational display screens. The following shows samples of each of the displays:

01:29:15
Saturday, 30-DEC-17

Temp: 21.1C 70F
Rel Hum: 35%
Baro: 102670 Pa STD

Lat. 4044.89841N
Lon. 7359.12640W
Sats Trk:10 Qual:2

The "STD" in the second display screen indicates that the barometric pressure is steady. The following table shows all of the possible displays for this item.

Display	Meaning
STD	Steady
R	Rising
R+	Rising Rapidly
F	Falling
F+	Falling Rapidly

Notes: This indicator requires the RPTR-OLED to have been operating for at least 3 hours in order to collect baseline data.

A change of ± 100 Pascals or greater over the last 3 hours indicates a rise or fall. A change of ± 200 Pascals or more over the last 3 hours indicates a rapid rise or fall.

4.1 RPTR-OLED pairing

4.1.1 Pairing overview

A long press of the B button (closest to the display) on the RPTR-OLED will cause the RPTR-OLED to attempt to "pair" with the clock. Pairing is necessary if you change the radio channel or baud rate on the clock, as the RPTR-OLED needs to know these settings to be able to properly communicate with the clock. The channel and baud rate are set via the clock's configuration menu (see LNKMNU / RFCHAN and LNKMNU / RFBAUD). The RPTR-OLED will then scan the radio channel range, transmitting "ping" packets and looking for the correct response from the clock. This procedure allows the RPTR-OLED to determine and then match its radio channel and baud rate to that of the clock. The information is then saved in non-volatile memory in the RPTR-OLED so that the procedure does not have to be performed again unless the radio channel or baud rate has been changed on the clock.

4.1.2 Pairing procedure

The clock should be powered on and operating normally. The GPS RPTR-OLED must have both antennas connected and also be powered on.

Note: The pairing procedure is somewhat more complicated when there is more than one clock within radio range. In the unlikely event that this situation applies to you, please refer to Appendix B for additional information.

Press and hold the B button on the RPTR-OLED for several seconds until the display on the RPTR-OLED shows the "FIND CLOCK" message. Then release the button to cause the RPTR-OLED to scan all channels for a clock. The display will show the channel currently being scanned, and if a clock is detected it will briefly display a message such as "CHAN 77 250K LOW". CHAN 77 shows that it found a clock at channel 77 (see LNKMNU / RFCHAN on the clock menu), a data rate of 250K (see LNKMNU / RFBAUD), and is operating at low radio power. If the clock is not found, the RPTR-OLED will briefly display the message "NOT FOUND". In this case, repeat the process after adjusting the orientation of the RPTR-OLED or physically moving it closer to the clock. You may also try changing the channel and baud rate on the clock before re-pairing.

4.1.3 Notes on pairing

The pairing process requires that the clock and RPTR-OLED be able to hear each other. During normal operation, the clock only has to hear the RPTR-OLED's broadcasts as it does not transmit data to the RPTR-OLED. You may need to move the RPTR-OLED closer to the clock to successfully pair the two devices and then relocate it to its desired location.

4.1.4 Hints to improve range

The RPTR-OLED operates at very low power levels within the crowded 2.4GHz ISM band. It shares these frequencies with Wi-Fi™ access points, Bluetooth®, wireless cameras, baby monitors, cordless telephones, and even microwave ovens.

The RPTR-OLED is not designed for long-range transmissions, just to allow you to locate it in a more convenient location without the need to run a long extension cord. The maximum range (which will be difficult to achieve in most environments) is approximately 100 feet. The wireless range you actually achieve will depend greatly on environmental conditions. If you are trying for extended distances, you may have to experiment with location, orientation of the RPTR-OLED's antenna, radio channel, and baud rate. Walls and other obstacles also degrade the signal.

Lower baud rates will typically have longer ranges, but higher baud rates will be more immune to certain types of sporadic interference. You can try setting a radio channel outside the Wi-Fi band, or between Wi-Fi channels, but be sure to stay within the legal operating frequencies for your country.

Note: In the United States, the allowed ISM band is 2.4GHz to 2.4835GHz, represented by channels 1-79 in the clock.

4.2 RPTR-OLED menu

The main menu is entered by a long press of the A button (closest to the antennas). Once in the main menu, a short press of the B button moves forward within the menus (or selections within a menu) and a short press of the A button moves backward. Within a menu, a long press of the A button selects an item for modification and short presses of the A or B buttons cycle through the various settings for that menu item. A long press of the A button confirms the currently displayed option, while a long press of the B button discards the change. In either case, a long button press exits that item's settings and returns to the main menu.

Notes: Selecting an option here does not change the RPTR-OLED's configuration until the "SAVE&EXIT" menu option is selected and confirmed.

It is normal for the RPTR-OLED to report "LOCK LOST" when exiting the menus as it is being reset to the new configuration.

During normal operation (not in menu mode) a long press of the B button is a shortcut to pair the RPTR-OLED with the clock.

4.2.1 FIND CLOCK

This item is used for automatic pairing of the RPTR-OLED with the clock. Confirming this item will cause the RPTR-OLED to scan all channels for a clock. The pairing procedure will scan through all of the channels at the lowest power and data rate, indicated by "P:0" (low power) and "B:0" (250K data rate). If the clock is not detected the scan will switch to the 1MBPS data rate. If the clock is still not found, the scan will try the 2MBPS

data rate. At that point, if the clock is still not found, the RPTR-OLED will switch to medium power and repeat the process at each data rate. If the clock is still not detected, the scan will repeat one more time at high power. The display will also show the channel currently being scanned. If a clock is detected the display will briefly show a message such as "CHAN 77 250K LOW". CHAN 77 shows that the RPTR-OLED found a clock at channel 77 (see LNKMNU / RFCHAN on the clock menu), a data rate of 250K (see LNKMNU / RFBAUD), and is operating at low radio power. If the clock was not found, the RPTR-OLED will briefly display the message "NOT FOUND".

Note: A long press of the B button on the RPTR-OLED is a shortcut for this function.

4.2.2 PING CLOCK

This menu item is used to send a "ping" (communication verification) packet to the clock. A successful ping will display a message in the form "PING! S45" on the RPTR-OLED and the text "*PING*" on the clock. The digits after S show the received signal strength in -dBm, with lower numbers indicating a stronger signal. If the RPTR-OLED is unable to ping the clock it will display the message "NO RSP".

4.2.3 RF CHAN

This item allows you to manually specify the radio channel for communicating with the clock. See LNKMNU / RFCHAN for the corresponding setting on the clock.

Note: This item as well as the subsequent RF POWER and RF BAUD items are normally configured automatically as part of the FIND CLOCK menu item.

4.2.4 RF POWER

Using this option allows you to change the transmit power of the RPTR-OLED. You may select from LOW, MED and HIGH. The default of LOW is normally sufficient, but if your clock and / or TimeLink receiver(s) are far away from the RPTR-OLED, you may need to change this value to MED or HIGH to ensure proper communication.

Note: This option only controls the strength of the radio signal transmitted by the RPTR-OLED; there is no corresponding option on the clock or TimeLink receiver as their radio transmitters only operate at low power.

4.2.5 RF BAUD

You may select a different data rate using this option. The default of 250K is normally sufficient. Selecting either 1MBPS or 2MBPS generally reduces the useful radio distance but also reduces susceptibility to interference from other devices such as cordless phones and microwave ovens. See LNKMNU / RFBAUD for the corresponding setting on the clock.

4.2.6 12/24 HOUR

The RPTR-OLED displays the date and time on its built-in display as well as transmitting them to the clock and / or TimeLink receiver(s). This item lets you select 12 HOUR or 24 HOUR display on the RPTR-OLED.

Note: This item and GMT OFFSET only adjust the time display on the RPTR-OLED itself. The RPTR-OLED always transmits time signals in UTC / GMT.

4.2.7 GMT OFFSET

This function lets you select your local time zone (offset from GMT) in 1 hour increments from -12 hours to +12 hours. As an example, EST is -5 hours.

Note: The RPTR-OLED does not have Daylight Saving Time (DST) tables. Therefore you will need to adjust the GMT OFFSET at the beginning and end of DST in order to display the correct local time on the RPTR-OLED.

4.2.8 TIME TWEAK

This item lets you "tweak" the time shown on the RPTR-OLED display *and* transmitted by radio to the clock and / or TimeLink receiver(s) in 100ms (1/10th of a second) increments. The range is -5000 (5 seconds slow) to +5000 (5 seconds fast).

Note: This item is cumulative with any adjustment set on the clock with GPSMNU / TWK16S.

4.2.9 TEMP CAL

Using this option you can change the temperature displayed on the RPTR-OLED and transmitted to other devices in 0.1C increments. The range is -5.0C to +5.0C (approximately -9F to +9F). If you have another thermometer, you can use this option to calibrate the temperature reported by the RPTR-OLED to match that thermometer.

Note: This item is cumulative with any adjustment set on the clock with GPSMNU / T# CAL.

4.2.10 RH CAL

This item adjusts the reported relative humidity. The range is -10% to +10%. Similar to TEMP CAL, if you have a hygrometer you can calibrate the RPTR-OLED to match the humidity displayed by your hygrometer.

Note: This item is cumulative with any adjustment set on the clock with GPSMNU / H# CAL.

4.2.11 BARO CAL

Similarly, this item adjusts the reported barometric pressure. The range is -99 Pascals to +99 Pascals. 1 Pascal is 0.01 millibar or approximately 0.0003 inches of mercury. As with TEMP CAL, you can use this option to calibrate the RPTR-OLED's sensor to match your barometer.

Note: This item is cumulative with any adjustment set on the clock with GPSMNU / B# CAL.

4.2.12 LED MODE

Using this option, you can select the behavior of the LED on the RPTR-OLED. PULSE causes the LED to pulse approximately once per second. SOLID will leave the LED on at all times. LED OFF disables the LED.

4.2.13 DISP MODE

This option controls the display on the RPTR-OLED. AUTO OFF turns off the display after 60 minutes of inactivity (no button presses) to prevent burn-in on the display. ON leaves the display on at all times. OFF always keeps the display off except when in the menus.

4.2.14 RESET ALL

This item resets the RPTR-OLED to factory defaults.

4.2.15 VERSION

This option displays the firmware version of the RPTR-OLED as well as the name of the installed lexicon (word list). For example, "RPTR V4.7 LEX:STNDRD" shows that the RPTR-OLED is running firmware 4.7 and has the standard lexicon installed.

Note: Lexicon names are limited to 6 characters as that is the maximum the clock can display.

4.2.16 RADIO TEST

This option is intended for manufacturing use only. Please do not select this option.

4.2.17 LNK SIGNAL

This test sends continuous echo packets to the MOD-SIX clock at a rate of 1 per second and reports the echo response signal level in the form Sxx. The digits after S show the signal level in -dBm, with lower numbers indicating a stronger signal. Each successfully received packet is indicated by a green flash from the RPTR-OLED LED. If the RPTR-OLED is unable to obtain a response from the clock it will display the message "—" and will flash the RPTR-OLED LED red to indicate a lost packet. Exit this test with a brief press of either the A or B menu button.

This test may help you locate the location with the best signal strength for the RPTR-OLED to communicate with the clock(s).

Notes: It is expected that there will occasionally be a lost packet as both the clock and the RPTR-OLED have other, higher-priority, tasks scheduled which may conflict with the test packets.

During the time this test is active, no other data is transmitted from the RPTR-OLED to the clock(s) or TimeLink receiver(s).

The TimeLink receiver does not currently support a similar function, so this test is only useful for determining the best location for the RPTR-OLED in relation to one or more clocks.

Refer to Appendix B for potential interactions if you are operating multiple MOD-SIX clocks from a single RPTR-OLED

4.2.18 GPS SIGNAL

This test helps you find a good location for the GPS antenna connected to the RPTR-OLED. With approximately 10 feet of GPS antenna cable, this allows the GPS antenna location to be experimented with to determine the best location. When activated, the test displays a brief "TRK/VIS" message on the RPTR-OLED display. The display then switches to displaying 2 numbers in the form "XX/YY". XX is the number of satellites actually being tracked (receiving a valid signal). YY is the number of satellites that are computed to be visible by being "above the horizon". Note that the GPS system does not take into account any obstructions between the satellite(s) and the RPTR-OLED. Therefore, the number of tracked satellites will almost always be lower than the number of visible ones. The LED on the RPTR-OLED will flash blue approximately once per second to show data being received from the on-board GPS processor. Exit this test with a brief press of either the A or B menu button.

Notes: During the time this test is active, no other data is transmitted from the RPTR-OLED to the clock(s) or TimeLink receiver(s).

When experimenting with moving the GPS antenna, allow things to settle down for a few minutes in the new location before deciding if the new location is an improvement. Also, note that varying numbers of satellites may be visible at any given time and that any change in tracked satellites may or may not actually be due to your movement of the GPS antenna.

4.2.19 SAVE&EXIT

In this menu item, you can save any changes you have made or discard them and revert to the previous configuration.

4.3 RPTR-OLED troubleshooting

When power is first applied to the RPTR-OLED the OLED display should display various informational messages and the LED should briefly flash. If neither happens when power is connected, verify that the power cord and AC adapter are working properly and that the outlet they are plugged into has power. If the RPTR-OLED does not power up after checking these items, contact badnixie@badnixie.com for assistance.

After the RPTR-OLED displays its version and other information when powered on, it then performs a variety of diagnostic tests. The test messages will normally cycle through the display quite rapidly as each test passes. Detailed descriptions of the individual tests are beyond the scope of this manual. If a test reports FAIL instead of PASS, contact badnixie@badnixie.com for assistance.

Note: The GPS TEST only tests communication between the CPU and GPS receiver module on the RPTR-OLED. It does not test the GPS antenna, antenna connection, or GPS signal.

If all the tests pass, the display will report "COLD START" to show that the GPS receiver is starting up. The display should then begin cycling between "ACQUIRING" (looking for GPS satellites) and a message such as "V T00 Q0". This information is mostly for manufacturing test purposes. However, the digits after "T" show the number of satellites in view. Once there are more than 3 satellites in view, the display will switch to the time and date informational screen.

If the display never changes from "COLD START" to "ACQUIRING", this usually indicates that there is a problem with the GPS antenna. Make sure that you have not interchanged the LNK antenna (stubby black pole) with the GPS antenna ("puck" on the end of a 10-foot cable).

Notes: If the DISP MODE menu option is set to OFF the display will go blank instead of displaying additional messages after the last test succeeds. You will need to set DISP MODE to AUTO OFF or ON in the menus to perform further troubleshooting steps.

It may take up to several minutes to achieve a solid GPS lock after the RPTR-OLED is powered on. If the display does not change to the time and date after 10 minutes, try relocating the GPS antenna to a different location. The digits after the T in

the cycling "ACQUIRING" message show how many satellites are visible, which may help you select a better location for the GPS antenna.

If the GPS signal is lost for some reason, the display will report "LOCK LOST". This is normally a temporary condition caused by an obstruction between the GPS antenna and the satellites. Normally the display will begin cycling between "ACQUIRING" and "V T00 Q0" and then back to the time and date once the satellite signal has been re-acquired. If the loss of signal persists, try disconnecting the power from the RPTR-OLED and then re-connecting the power after a few minutes. This will cause the RPTR-OLED to re-initialize and perform its self-tests, which may help determine if a fault exists.

Note: It is normal for the RPTR-OLED to report "LOCK LOST" when exiting the menus as the RPTR-OLED is being reset to the new configuration.

5 The keyfob (Optional)

The keyfob is an optional remote control which can be used to configure and operate the clock via a convenient hand-held device. Depending on your preference the keyfob can be configured to allow full control of the clock via the setup menus or be restricted to a subset of functions which don't change the clock's setup options. The keyfob can also be completely ignored by the clock if so desired.

The clock and keyfob are normally already paired with each other. If you change the radio channel, baud rate, or clock address (see menu options LNKMNU / RFCHAN, LNKMNU / RFBAUD, and LNKMNU / ADDR, respectively) you will need to re-pair the clock and keyfob.

Figure 5–1 Keyfob

Each button on the keyfob performs a specific function. Additionally, certain combinations of buttons have additional functions. These are described briefly in the following table.

Notes: Up is defined as the button closest to the key ring loop.

When multiple buttons are shown in the table, they should both be pressed simultaneously and held until the keyfob LED flashes (approximately 5 seconds).

Button(s)	Function
Up	Equivalent to rotating the control knob clockwise (normally TMR ON - see TMRMNU)
Down	Equivalent to rotating the control knob counterclockwise (normally TMROFF)
Left	Alternates between NX OFF - clock display off and NX PIR - clock display controlled by optional PIR sensor
Right	NX ON - turn clock display on
Center	Equivalent to pressing the control knob for a brief or long press
Left + Right	Pair keyfob with clock
Center + Up	Increment keyfob address (see LNKMNU / ADDR)
Center + Down	Decrement keyfob address (see LNKMNU / ADDR)
Up + Down	Display keyfob address and firmware version on clock
Center + Right	Factory test mode (see below)

There are some interactions between the right button on the keyfob (NX ON) and other clock settings. Turning on the tubes with the keyfob will last only until the next clock timer interval (see Section 3.6) would turn the tubes off. Similarly, if the optional PIR sensor is installed and PIR MD is set to ON, a press of the right button on the keyfob will turn the tubes on but the PIR timeout interval (see Section 3.6.8) will start counting down and if no activity is detected by the PIR sensor the tubes will turn off after the configured PIR timeout interval.

5.1 Keyfob pairing

5.1.1 Pairing overview

A long press on the left and right keyfob buttons will cause the keyfob to try to "pair" with the clock. Pairing is necessary if you change the radio channel or baud rate on the clock, as the keyfob needs to know these settings in order to be able to properly communicate with the clock. The radio channel and baud rate are set in the clock's configuration options (LNKMNU / RFCHAN and LNKMNU / RFBAUD). The keyfob will then scan the radio channel range, transmitting "ping" packets and looking for the correct response from the clock. This procedure allows the keyfob to determine and then match its radio channel and baud rate to that of the clock. The information is then saved in non-volatile memory so that the procedure does not have to be performed again unless the radio channel or baud rate has been changed on the clock.

5.1.2 Pairing procedure

The clock should be powered on and operating normally. The keyfob should have a fresh battery in it (one is pre-installed in the keyfob). You must be able to read messages displayed on the clock from where you are using the keyfob.

Press and hold the left and right buttons on the keyfob simultaneously until the LED on the keyfob flashes orange once, then release. This will normally happen within 10 seconds of pressing the buttons. The clock will then display a message like "FOB-0". The "0" in the message indicates that the keyfob is configured to address 0. If your clock's configuration also has its LNKMNU / ADDR option set to address 0, you're all set.

5.2 Keyfob address

If you have multiple clocks on the same radio channel, but want to control them independently with a separate keyfob for each, you will need to change the keyfob's address. To increment the keyfob address press the center and up buttons on the keyfob simultaneously for approximately 5 seconds until the LED on the keyfob flashes orange once, then release. The clock will then display a message such as "F1 3/2" indicating that the keyfob is now at address 1 and the keyfob firmware version is 3.2. Similarly, you can decrement the keyfob address by pressing the center and down buttons on the keyfob simultaneously for approximately 5 seconds until the keyfob LED flashes orange. The keyfob will also display the address on its LED per the following table. Continue as needed to set the desired keyfob address.

Address	LED Display
0	orange flash / orange flash
1	orange flash / 1 green flash / orange flash
2	orange flash / 2 green flashes / orange flash
3	orange flash / 3 green flashes / orange flash
...	...
7	orange flash / 7 green flashes / orange flash

If necessary, change the LNKMNU / ADDR setting on the clock to match the address set on the keyfob.

You can quickly determine the configuration of a paired keyfob by pressing and holding the up and down buttons simultaneously for approximately 5 seconds until the keyfob LED flashes orange. The clock will then display a message of the form "F# x/x" where # indicates the keyfob's current address (0-7) and x/x indicates the keyfob's firmware version.

Note: Internal clock and RPTR-OLED messages have priority over informational messages from the keyfob. It is best to pair and / or change the address of the keyfob when the clock is expected to continue its normal time display. Otherwise, the informational display message from the keyfob may not appear on the clock, even if the function requested has been performed. You may press the center button on the keyfob briefly to "get the clock's attention" and revert to time display in order to ensure messages from the keyfob are displayed.

5.3 Keyfob test mode

The keyfob includes a factory test mode which is documented here for completeness. Press and hold the center and right buttons until the amber LED on the keyfob blinks. Then release the buttons. The keyfob LED should illuminate solid green. Press and hold any button until the green LED turns off. This tests the basic processing functions of the keyfob, the LED, and the buttons.

5.4 Keyfob uses

There are many possible uses for the keyfob. In this section we will cover some of them. We're sure you can come up with some more good ideas. All of the clock's functions can be controlled by the keyfob, so you never need to use the control knob on the clock. This can be quite useful if the clock is out of convenient reach.

Note: It is possible to "paint yourself into a corner" by using the keyfob to change the clock's radio channel, baud rate, or address. If you change any of those settings, once you exit the menu (applying your changes), the clock will no longer respond to the keyfob. In this case, you will need to re-pair the keyfob with the clock and / or change the keyfob's address to match the clock.

5.4.1 Bedside remote control

The clock can be configured to turn the tubes off and back on at specific times (see the TMRMNU settings). It can also be set to turn the tubes off when the room is dark (the DIM and LVLSET menu settings). The keyfob provides another way to control the clock display remotely. The tubes can be immediately turned off and back on with the left and right keyfob buttons, respectively. You can also enable and disable turning off the tubes at the scheduled times using the up and down buttons on the keyfob.

5.4.2 "Valet Mode" in a display case

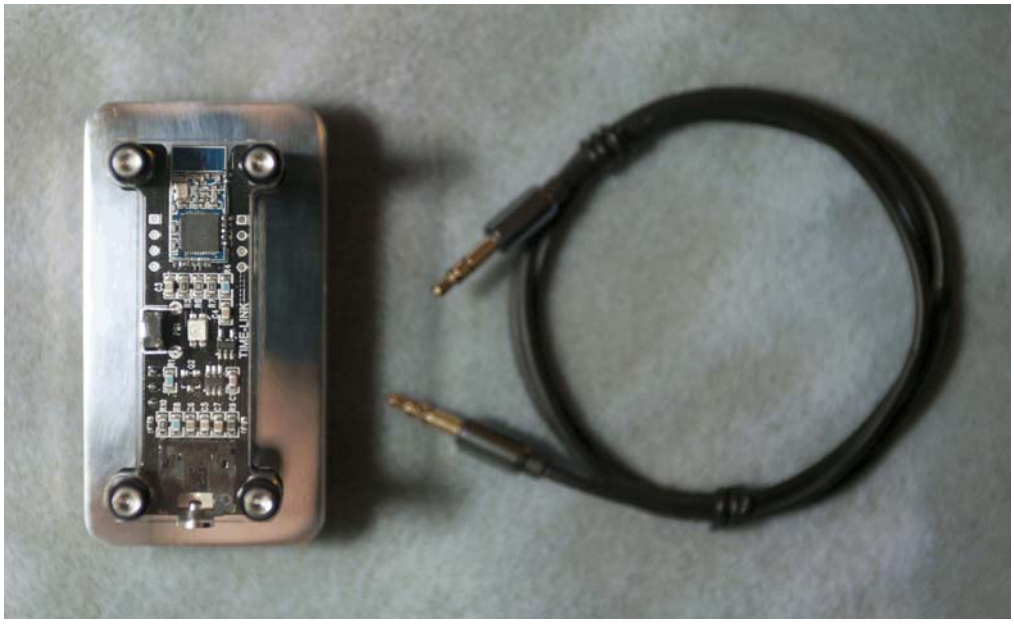
You may wish to install the clock inside a display case. Perhaps you'd like to exhibit it in a museum. In this situation, you might want to allow staff to turn the tubes on and off with the keyfob, but prevent them from making any changes to the clock's configuration. Setting the clock's LNKMNU / FOB MD option to VALET will enable this mode.

6 The TimeLink receiver (Optional)

This chapter introduces the TimeLink receiver, which allows you to provide GPS time synchronization, as well as other GPS data such as latitude and longitude, to one or more 3rd-party clocks via a short-range radio link to the RPTR-OLED. This is convenient if you have a 3rd-party clock (with support for an external GPS receiver) in a location without good GPS reception. If you already have a MOD-SIX Nixie Clock System with a RPTR-OLED, all you need to send the GPS signal to a 3rd-party clock is a TimeLink receiver with the appropriate cable for your clock.

If you are a horophile and have another clock near your MOD-SIX, the combination of the RPTR-OLED and TimeLink receiver will let you adjust timekeeping so that both clocks are perfectly synchronized via the TWEAK functions on both devices.

Figure 6–1 TimeLink receiver and cable



Notes: The cable shipped with your TimeLink receiver may appear different than the one shown in the picture, depending on the type of 3rd-party clock you will be connecting the TimeLink receiver to.

It is possible to use the RPTR-OLED and TimeLink receiver without any other MOD-SIX components, although this chapter refers to the TimeLink receiver as an optional add-on component to the MOD-SIX System.

The sections below give examples for specific clocks that we have tested the TimeLink receiver with, as well as information to allow you to connect the TimeLink receiver to other clocks. If you have success (or failure) with a clock not specifically listed below, we would like to hear from you. You may email the information to badnixie@badnixie.com.

Note: We will work with 3rd-party clock designers to add TimeLink receiver support for their clocks. You may ask them to contact us at the above email address.

The TimeLink receiver works with many 3rd-party clocks which support GPS time synchronization. There are three common varieties of GPS connector on 3rd-party clocks:

- Clocks with 3.5mm "headphone" type GPS connectors
- Clocks with standard female mini-DIN ("PS/2 style") GPS connectors
- Clocks with reversed-pinout female mini-DIN GPS connectors

Caution: It is important to ensure that you are using the correct type of cable for your 3rd-party clock. If an incorrect cable is used, this can result in damage to the TimeLink receiver or the 3rd-party clock.

The top of the TimeLink receiver has a small clear LED which displays a variety of colors, representing status information. On power-up, the TimeLink receiver will blink blue and then display its firmware version number. Red blinks indicate the major version, while green blinks indicate the minor version. For example, 4 red blinks followed by 1 green blink indicates firmware V4.1. During normal operation, the LED will blink red approximately once per second as long as the TimeLink receiver is receiving data from the RPTR-OLED (unless disabled by the user - see Section 6.7.1). The blink indicates a data packet (time signal and additional data such as GPS coordinates) was received from the RPTR-OLED.

As long as the TimeLink receiver is getting a good signal from the RPTR-OLED, GPS data will be fed to the attached 3rd-party clock nearly instantly after the clock is powered on. A pushbutton is also located along the top edge of the TimeLink receiver near the LED. This button is used to configure various options. Refer to Section 6.7 for further information on the operation of this button.

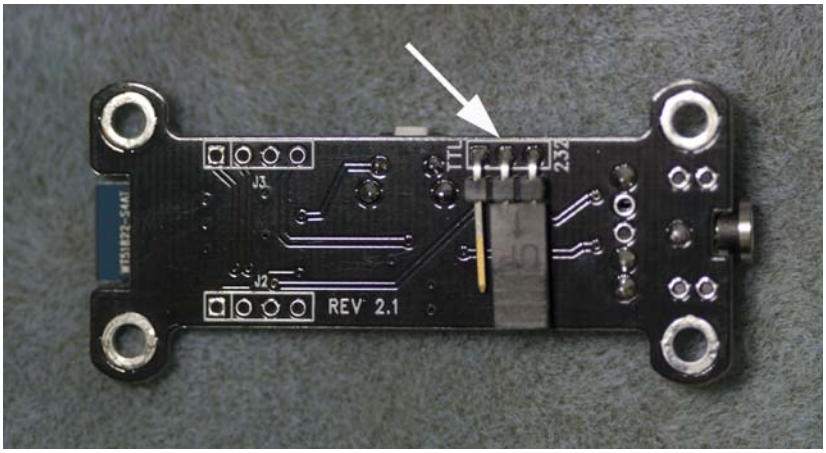
6.1 RS-232 / TTL selection

Some 3rd-party clocks use an RS-232 signal for data from the TimeLink receiver to the clock, while others use a TTL signal. Selecting the incorrect signal has the potential to damage the TimeLink receiver and / or the 3rd-party clock, so it is important to determine which type of signal your clock requires and verify that the TimeLink receiver is configured appropriately

before connecting them together. The instructions for specific 3rd-party clocks mentioned below will state whether RS-232 or TTL is required. If you are connecting the TimeLink receiver to a clock not specifically listed below, consult the clock's documentation or contact the supplier to determine if the clock requires an RS-232 or TTL signal.

Caution: Ensure the jumper is in the correct position (RS-232 or TTL) before connecting the TimeLink receiver to the 3rd-party clock. An incorrect setting may damage either the TimeLink receiver or the 3rd-party clock.

Figure 6–2 TimeLink receiver bottom view (baseplate removed)



The underside of the TimeLink receiver has a 3-pin jumper with one side labeled TTL and the other side labeled 232. A black plastic Berg jumper connects either the 232 pin or the TTL pin to the center pin. Verify that the jumper on the bottom of the TimeLink receiver is set appropriately for your clock.

Note: The single exposed gold jumper pin you see indicates which option is *not* selected - the actual setting is done by the position of the black plastic Berg jumper across the other 2 pins.

If you need to change the setting, ensure that the TimeLink receiver is unplugged. If it is already plugged into the 3rd-party clock, remove power from the clock. Do **NOT** disconnect the TimeLink receiver from a powered-on clock - instead, remove power from the clock first, then disconnect the TimeLink receiver from the clock only if necessary. Next, carefully slide the black plastic Berg jumper off of the pins and reinstall it in the other position.

Note: You may find it easier to temporarily remove the TimeLink receiver circuit board from its base in order to get better access to the jumper. If you do, be sure to reassemble the unit before applying power.

If you disconnected the TimeLink receiver from the clock, re-connect it at this point. Then apply power to the clock and verify proper clock GPS operation as described in the sections below.

6.2 Installing on clocks with 3.5mm connectors

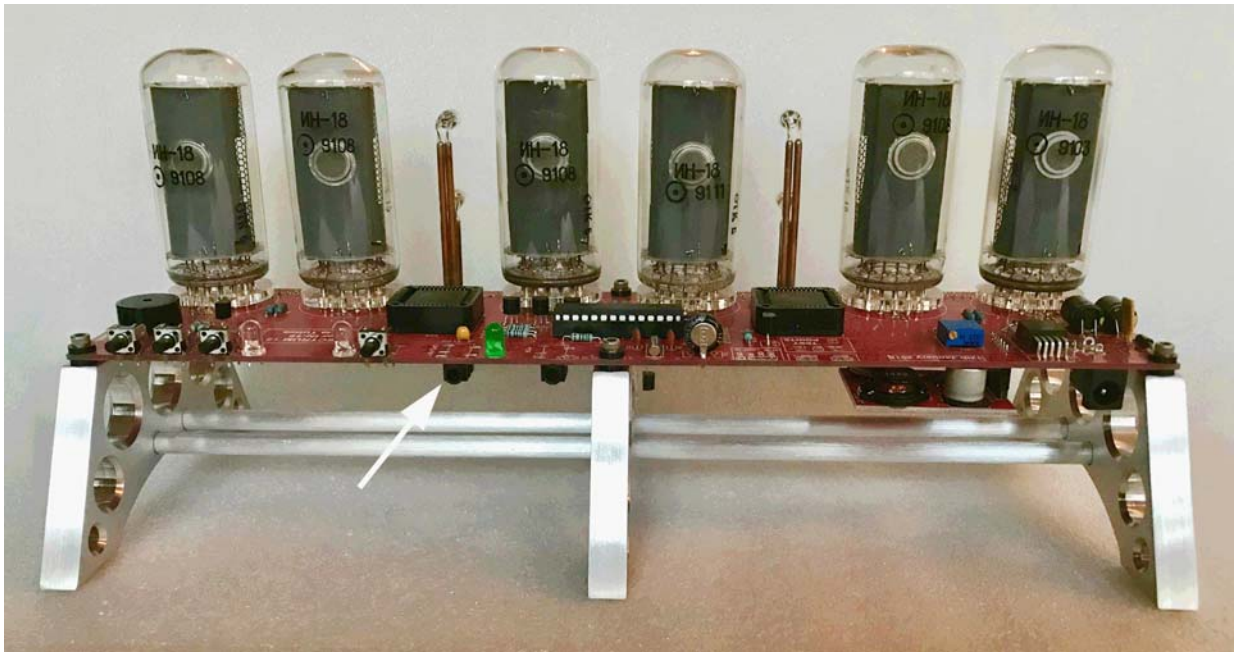
6.2.1 PV Electronics clocks

A large number of clocks from PV Electronics are supported. Many models of these clocks include optional GPS support but will use an internal time source if a GPS receiver is not connected. More information is available at: https://www.pvelectronics.co.uk

Refer to the above web page to see if a particular model of clock is supported and to determine the location of the 3.5mm GPS connector on your specific clock. PV Electronics clocks require the TimeLink receiver RS-232 / TTL jumper to be set to TTL.

If the clock has an existing GPS receiver connected to it, power off the clock and disconnect the GPS receiver. Re-apply power to the clock and use the clock's setup mode to enable GPS mode, set the GPS baud rate to 4800, and select the appropriate time zone. You may also wish to set the clock to an incorrect date and time in order to verify that the TimeLink receiver can correctly synchronize the clock.

Figure 6–3 Example PV Electronics GPS connector location



Caution: Many PV Electronics clocks have a second 3.5mm connector for a PIR (passive infrared) sensor. Ensure that the TimeLink receiver is plugged into the GPS connector and not the PIR connector.

Using the wrong connector can cause damage to the TimeLink receiver, clock, or both.

Remove power from the clock and plug one end of the supplied 3.5mm cable into the TimeLink receiver. Plug the other end of the cable into the GPS connector on the clock. Apply power to the clock. The clock display should change to show the correct time and date (if you changed it above) after only a few seconds and the LED on the TimeLink receiver should be blinking red approximately once per second. If the time is incorrect or the TimeLink receiver LED is not blinking, refer to the Troubleshooting section below.

6.2.2 Mr. Nixie Clocks

Many clocks from Mr. Nixie are supported. Most models of these clocks include optional GPS support but will use an internal time source if a GPS receiver is not connected. More information is available at: http://www.nixiekits.eu

Refer to the above web page to see if a particular model of clock is supported and to determine the location of the 3.5mm GPS connector on your specific clock. These clocks support both RS-232 and TTL GPS connection options. Ensure that the TimeLink receiver RS-232 / TTL jumper is set to match the setting on your clock. Refer to Section 6.2.1 for information on configuring the clock and connecting the TimeLink receiver.

6.2.3 Other clocks with 3.5mm connectors

Most other 3rd-party clocks with 3.5mm GPS connectors use the same pinout as the PV Electronics and Mr. Nixie clocks above. You will also need to know how to set the clock's GPS baud rate as well as whether the clock uses RS-232 or TTL signals. Obtain this information from your clock's supplier.

If your clock uses the same pinout as the PV Electronics and Mr. Nixie clocks, refer to Section 6.2.1 for information on configuring the clock and connecting the TimeLink receiver.

If your clock does not use the same pinout, refer to Section 6.5 for information on constructing a custom cable.

Caution: A custom 3.5mm / 3.5mm cable will not have the same pinout on each end. Therefore it has a "clock end" and a "TimeLink receiver end" and it is important to plug the correct end of the cable into each device to prevent damage to the clock and / or the TimeLink receiver. You may wish to label the ends of the custom cable to avoid confusion in the future.

6.3 Installing on clocks with standard mini-DIN

This is a very common configuration. Most clocks with a female mini-DIN GPS connector fall into this category and can operate with the TimeLink receiver instead of a directly-connected GPS receiver.

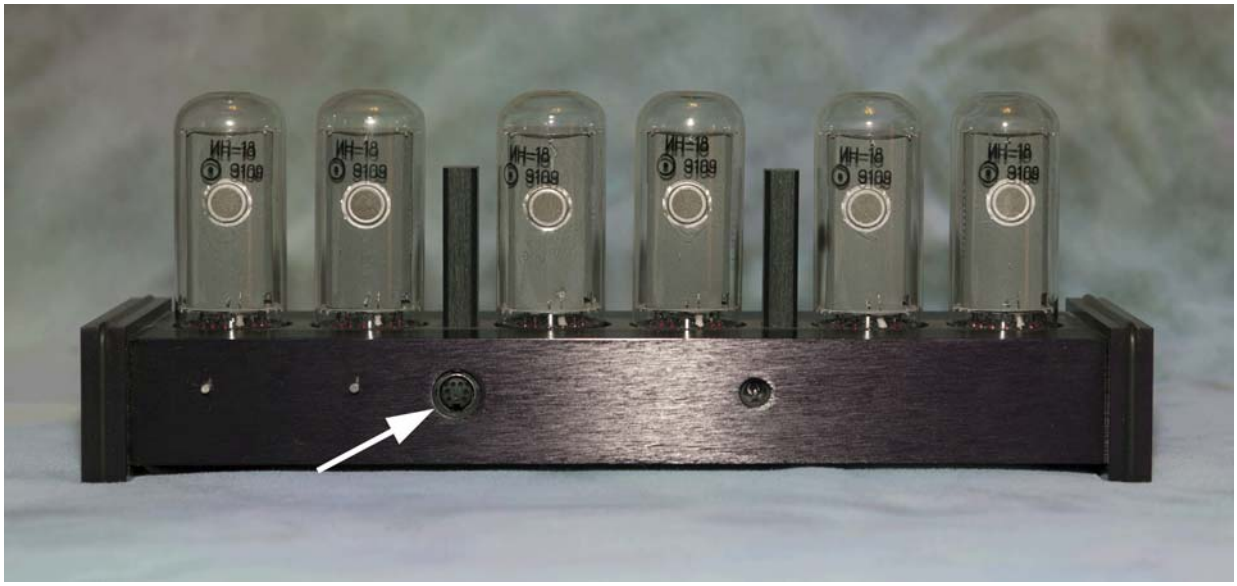
You may order a pre-made mini-DIN cable from badnixie@badnixie.com or you may construct your own. If you build your own cable, refer to Section 6.5 for more information.

6.3.1 NixiChron clocks

The NixiChron clock by Jeff Thomas is supported, as well as many other clocks from the same designer. More information is available at: http://www.nixie.dk/~jthomas/nixichron.html

First, confirm that your NixiChron clock has firmware which supports generic GPS receivers. Power off the NixiChron, wait a few seconds and power it back on. The clock will display a 6-digit date, such as 040609. This indicates the firmware date code, in the format MMDDYY. Firmware 040604 and older does not support any GPS receiver other than the one that shipped with the clock. Firmware 110105 and newer supports generic GPS receivers and will work with the TimeLink receiver. If you need updated firmware, email badnixie@badnixie.com for information on obtaining a firmware update for your NixiChron.

Figure 6–4 NixiChron GPS connector location



Confirm that the TimeLink receiver RS-232 / TTL jumper is set to the RS-232 position as shown in Section 6.1 and if not, change it before proceeding.

Power off the NixiChron and unplug the existing GPS cable, as shown in the figure above. Plug the TimeLink receiver mini-DIN cable into the clock, using the same connector. Power on the clock. After displaying the firmware date code and doing a tube test, the clock should report the correct date and time. If you have enabled GPS coordinate display, the GPS coordinates should also display at the specified interval.

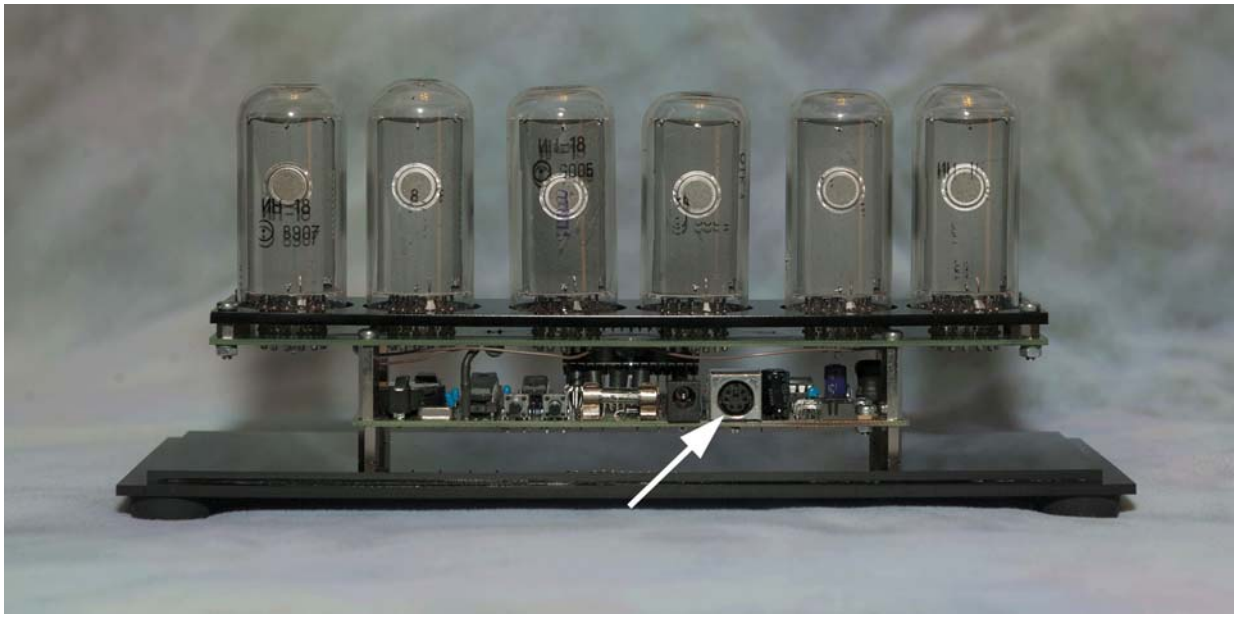
Caution: Per the NixiChron documentation, never connect or disconnect any GPS device from the clock while the clock is powered on.

If the clock does not display the time but instead starts counting up from "0000", it did not detect a valid GPS signal from the TimeLink receiver. Refer to the Troubleshooting section below.

6.3.2 TubeHobby NCV2.1 clocks

The TubeHobby NCV2.1 is a series of clock kits, available in a variety of configurations. They include optional GPS support but will use an internal time source if a GPS receiver is not connected. More information is available at: http://tubehobby.com

Figure 6–5 TubeHobby NCV2.1 GPS connector location



If the clock has an existing GPS receiver connected to it, power off the clock and disconnect the GPS receiver. Re-apply power to the clock and use the clock's setup mode to select the appropriate time zone. You may also wish to set the clock to an incorrect date and time in order to verify that the TimeLink receiver can correctly synchronize the clock. The NCV2.1 clock detects the presence of a GPS receiver automatically and

no special configuration other than setting the time zone is needed on the clock.

Confirm that the TimeLink receiver RS-232 / TTL jumper is set to the RS-232 position as shown in Section 6.1 and if not, change it before proceeding.

Plug the TimeLink receiver into the GPS connector on the clock. Apply power to the clock. The clock display should change to show the correct time and date (if you changed it above) after only a few seconds and the LED on the TimeLink receiver should be blinking red approximately once per second. If the time is incorrect or the TimeLink receiver LED is not blinking, refer to the Troubleshooting section below.

6.3.3 Other standard mini-DIN clocks

Installation on other 3rd-party clocks with standard female mini-DIN GPS connectors should be very similar to the above. First, determine if your clock requires an RS-232 or TTL signal from the GPS receiver. Consult your clock's documentation or the supplier to confirm which signal is needed. Refer to Section 6.1 to verify that the jumper on the TimeLink receiver is set appropriately. Next, power off the clock and unplug the existing GPS receiver (if installed) and then plug the TimeLink receiver mini-DIN cable into the clock's GPS connector. Then reapply power to the clock and verify that it is reporting the correct date and time (and latitude / longitude, if the clock includes that feature).

Note: Your 3rd-party clock may require configuration to enable and / or configure its GPS receiver connection. Refer to your clock's documentation or contact the supplier for additional information.

If the date and time are incorrect or the LED on the TimeLink receiver is not blinking red approximately once per second, refer to the Troubleshooting section below.

6.4 Installing on clocks with reversed mini-DIN

The reversed connector version of the TimeLink receiver cable is exactly what it sounds like - the pins in the mini-DIN connector are in the opposite sequence from a standard GPS plug. The only known example of this type is the Jeff Thomas / Pete Hand GPS FLW clock.

You may order a pre-made mini-DIN cable from badnixie@badnixie.com or you may construct your own. If you build your own cable, refer to Section 6.5 for more information.

Caution: If you are using a pre-made cable, ensure that it is the GPS FLW version as indicated by a label with text "GPSFLW Only!" near the mini-DIN plug end. Using a standard mini-DIN cable can damage both the TimeLink receiver and the GPS FLW clock it is attached to.

6.4.1 GPS FLW clocks

The GPS FLW is a modern re-implementation of a design from the 1970's. It displays random words selected from a database on 4 tubes, as well as displaying the time. It includes optional GPS support but will use an internal time source if a GPS receiver is not connected. More information is available at: http://www.nixie.dk/~jthomas/gpsflw.html

Figure 6–6 GPS FLW GPS connector location

Power off the GPS FLW clock and disconnect any GPS receiver from the clock. At this point, you might want to reapply power to the clock and set it to an incorrect time, in order to verify that the TimeLink receiver can correctly synchronize the clock. If you do this, power the clock off after completing the time setting procedure. The GPS FLW clock detects the presence of a GPS receiver automatically and no special configuration is needed on the clock.

Confirm that the TimeLink receiver RS-232 / TTL jumper is set to the RS-232 position as shown in Section 6.1 and if not, change it before proceeding.

Plug the TimeLink receiver into the GPS connector on the clock as shown by the red arrow in the above picture. Apply power to the clock. The clock display should change to show the correct time and date (if you changed it above) as it cycles through its word display, normally once per minute. The TimeLink receiver LED should be blinking red approximately once per second. If the time is incorrect or the TimeLink receiver LED is not blinking, refer to the Troubleshooting section below.

6.5 Installing on clocks with other connectors

If you have a clock which uses some other GPS connection method, you will need to build a custom cable to connect it to the TimeLink receiver. This section will provide you with the information needed to construct the cable.

Note: If you are not experienced in making cables, you may wish to have someone else fabricate the cable for you. Custom cables may be available for purchase from badnixie@badnixie.com

The following tables provide information on the pinouts and signal levels of the TimeLink receiver 3-conductor 3.5mm connector.

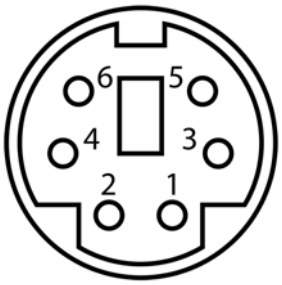
Pin	Description
Tip	Power input to TimeLink receiver, 4.0V to 5.5V positive with respect to ground, current < 23mA
Ring	Serial GPS data from TimeLink receiver, 4800 baud, 8 data bits, no parity and 1 stop bit (8N1) RS-232 or TTL †
Sleeve	Ground

†The only GPS NMEA sentences provided by the TimeLink receiver are $GPTXT (at power-up) and $GPRMC (once per second). $GPRMC data includes only the date / time, latitude / longitude, validity flag, and checksum. Other $GPRMC data is either omitted or set to 0, as needed.

Jumper	Signal level
RS-232	-5V to + 3.3V †
TTL	0V to + 3.3V

†Negative 5V nominal, the actual value will be inverted power input voltage.

Figure 6–7 Mini-DIN connector (clock / socket side)



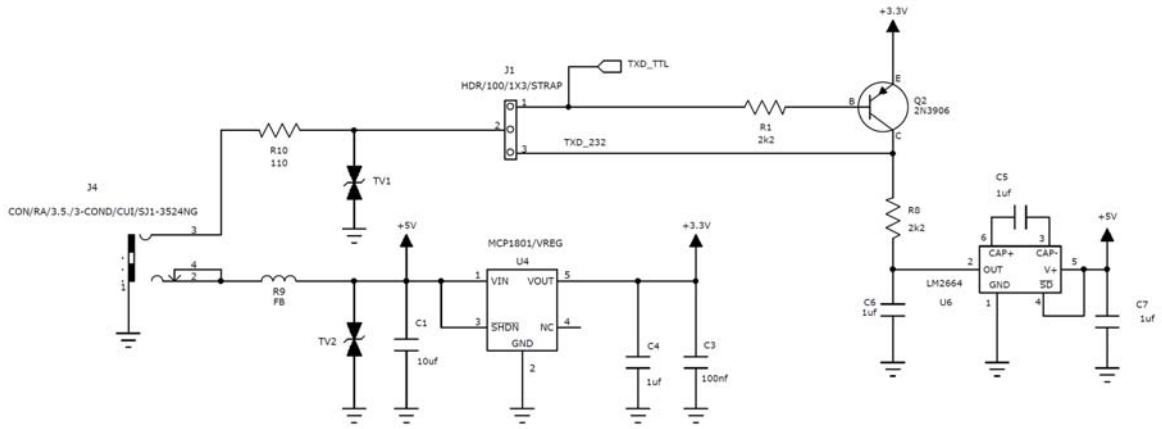
Caution: This illustration shows the connector on the clock (socket) side. Pin numbering on the TimeLink receiver cable (plug) side is the mirror image of this diagram.

The following table shows the function of each mini-DIN pin for both normal and reversed (GPS FLW) connectors. There are a variety of different diagrams with different pin numbering; the numbering shown in this table was verified to match the connector illustration above.

Pin	Normal mini-DIN	GPS FLW mini-DIN
1	Ground	+5V power
2	+5V power	Ground
3	Not connected	Not connected
4	Not connected	Not connected
5	GPS data	Not connected
6	Not connected	GPS data

Figure 6–8 shows the signal output section of the TimeLink receiver.

Figure 6–8 TimeLink receiver schematic (partial)



Caution: Double-check your work before connecting a custom cable to the TimeLink receiver and clock. An incorrectly wired cable has the potential to damage the TimeLink receiver, clock, or both.

Note: You may want to label your custom cable for future reference, particularly if you have several clocks which use different connectors.

If you create a custom cable for a clock not covered in the above sections, we'd like to add a section to this manual to describe it. Please contact us at badnixie@badnixie.com with information about the clock, such as

the clock model and / or name and how to contact the supplier, as well as details of the cable you built for it.

6.6 Troubleshooting

Confirm that the TimeLink receiver powers up properly and displays the firmware revision as described at the beginning of this chapter and that the LED on the TimeLink receiver is blinking red approximately once per second. If the TimeLink receiver powers up properly but there are no red blinks after power-up, either the blink feature has been turned off by the user (see Section 6.7.1), the TimeLink receiver is either too far away from the RPTR-OLED or it is set to a different radio channel and / or data rate.

Try temporarily setting the 3rd-party clock and TimeLink receiver up closer to the RPTR-OLED and / or re-pairing the TimeLink receiver as described in Section 6.7.2. If the LED on the TimeLink receiver does not blink at all during power-up, either the TimeLink receiver is defective, there is a problem with the cable (perhaps the wrong type of cable), or the 3rd-party clock is not providing power to the TimeLink receiver.

If the LED on the TimeLink receiver blinks red approximately once per second but the 3rd-party clock does not appear to be receiving a good time signal, confirm that the clock has GPS enabled (on some clocks, GPS is required, while on others it is an option) and that the clock expects GPS data at 4800 baud GPS. Also, confirm that the RS-232 / TTL jumper (see Section 6.1) is set appropriately for your 3rd-party clock model.

If the clock is apparently receiving a good GPS signal from the TimeLink receiver but the time is incorrect, verify that the time zone is configured correctly on the clock. Most 3rd-party clocks only support hour offsets for time zones, so a clock displaying the correct minutes and seconds but an incorrect hour is a clue that the time zone is set incorrectly on the clock. Some clocks allow minute offsets in their time zone settings. To see if this is the problem, power off the clock and unplug the TimeLink receiver. Power the clock back on and set both the hours and minutes to incorrect values. Power the clock off, re-connect the TimeLink receiver and power the clock back on. If the time displayed by the clock changes, it is receiving a good signal from the TimeLink receiver and the issue is probably an incorrect time zone setting on the clock. If the time displayed on the clock does not change, there is likely a problem with the TimeLink receiver or its cable, an incorrectly set RS-232 / TTL jumper, a configuration error (such as an incorrect baud rate or GPS not enabled) on the 3rd-party clock, or the clock does not see the data from the TimeLink receiver as a valid GPS signal.

Note: While the TimeLink receiver has been tested with many 3rd-party clocks, it is possible that there are clocks which require emulation of additional GPS sentences in order to operate with the TimeLink receiver.

Another potential issue with a 3rd-party clock displaying an incorrect hour (off by one) is an improperly configured DST option on the clock. Different models of clocks may or may not support DST at all, or may have out-of-date DST tables as DST start and end dates are somewhat frequently changed by legislation. When in doubt, disable DST completely on the

clock and change the time zone offset to compensate for DST. This does mean that you will need to change the time zone offset twice a year at the start and end of DST. If this becomes annoying, you may want to contact your 3rd-party clock's supplier to see if newer firmware with updated DST support is available.

6.7 Configuration

The TimeLink receiver has several configuration options set by operating the pushbutton on the top edge of the TimeLink receiver. The button has an obvious tactile "click" when pressed, so you'll know when you have activated it.

Note: Do not use excessive pressure to operate the button as this can damage the button or other components.

6.7.1 LED disable

The red blinking status LED on the TimeLink receiver is usually a convenient feature, but it can sometimes become a distraction. A brief press of the button will disable the blinking LED and turn it off completely. A second brief press will re-enable it, confirmed by a single blue blink. This setting is remembered, even if the 3rd-party clock or TimeLink receiver is powered off.

6.7.2 Pairing procedure

As shipped, both the RPTR-OLED and TimeLink receiver operate on radio channel 77 at a data rate of 250K.

If your RPTR-OLED is operating on a different channel and / or data rate and you are adding one or more TimeLink receivers to that system, you will need to pair each TimeLink receiver to the RPTR-OLED in the MOD-SIX System.

Note: While both the RPTR-OLED and TimeLink receiver have a pairing function, you will need to perform the pairing operation on the TimeLink receiver - the RPTR-OLED pairing function only discovers the clock, not the TimeLink receiver.

To pair the TimeLink receiver, press and hold the button for longer than 5 seconds, then release. The status LED will flash blue to indicate that the pairing procedure has been initiated. The LED will flash various colors as it scans for a RPTR-OLED within range. If it finds one, the LED will flash green once, while if it cannot find one, the LED will flash red once. Assuming the pairing was successful, the LED should begin blinking red approximately once per second.

The pairing procedure requires a strong signal. If you are unable to pair the units try temporarily relocating the clock with the TimeLink receiver closer to the RPTR-OLED while pairing. After successful pairing, you can move the clock and TimeLink receiver back to the desired location. You may also need to change the transmit power on the RPTR-OLED to MED

or HIGH from the default of LOW if the TimeLink receiver still does not receive data when it is installed in the desired location.

7 Fonts

The clock can display digits in a variety of fonts, from the standard one to ones that are funky or downright weird. This chapter provides illustrations of the fonts which can be selected, in order to help you pick the one that suits you best. A complete list is also available from the clock itself in the configuration menu.

Please note that the segments shown in the following illustrations are deliberately shortened in order to make it obvious where one ends and another begins. In actual operation, these will look like completed lines from one edge to the other. Each font shown below represents the numbers 0-4 across the top line and 5-9 across the bottom line.

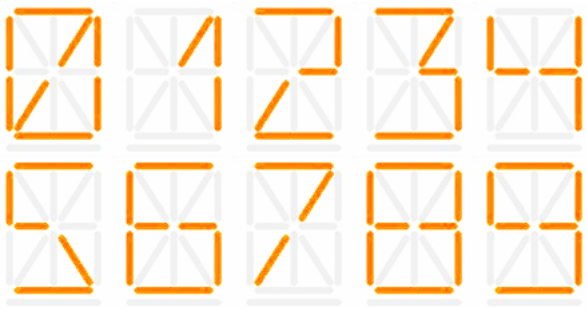
7.1 Quick selection of fonts

It is possible to directly select the font the clock uses from within the font catalog, so if you see a font you'd like to try you can select it here. Simply do a long press of the control knob while a font sample (not a font name) is displaying. After a short period, the display will show a "SETFNT" message. When you release the knob, the message will change to "CONFRM". Perform another long press to select this font, or rotate the knob one click to "ABORT" the font selection and return to the font catalog.

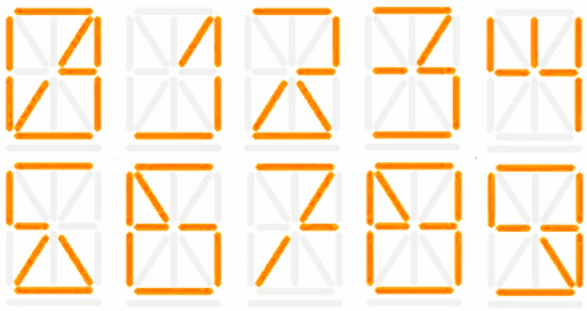
7.2 The font catalog

7.2.1 STNDRD

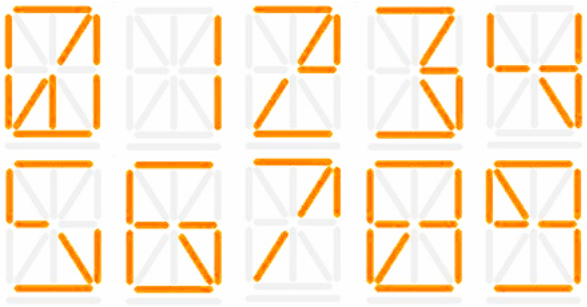
This is the standard font for the clock. While it might be considered rather boring (particularly compared with some of the other fonts in the clock), it maximizes readability.



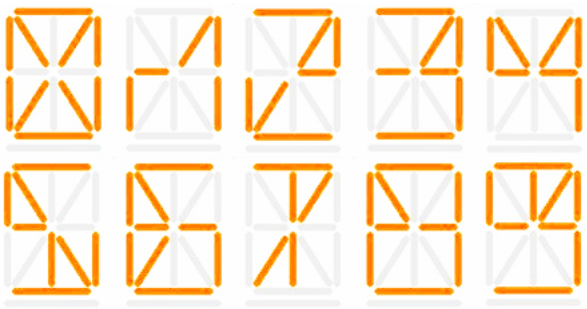
7.2.2 ALIEN



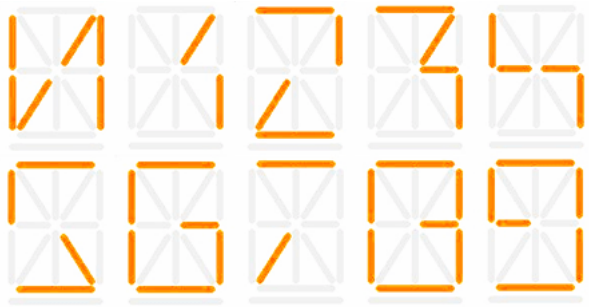
7.2.3 STINGY



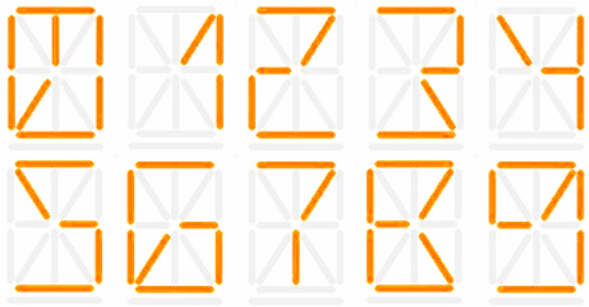
7.2.4 OUTLND



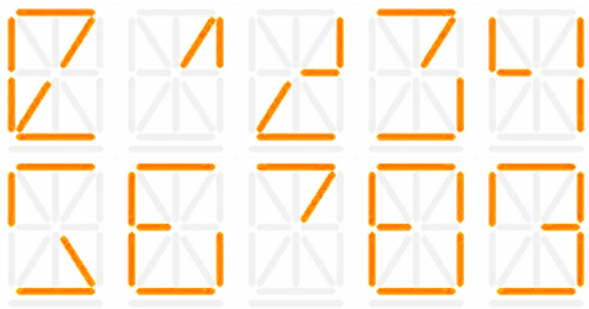
7.2.5 STOLEN



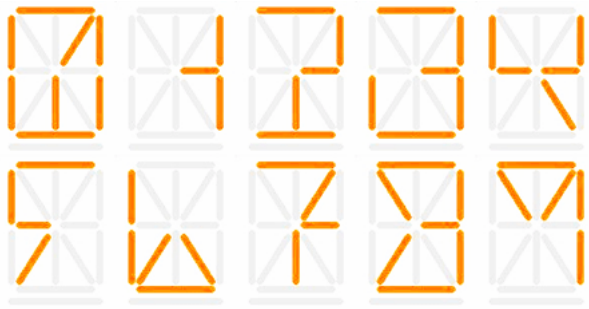
7.2.6 GRUNGE



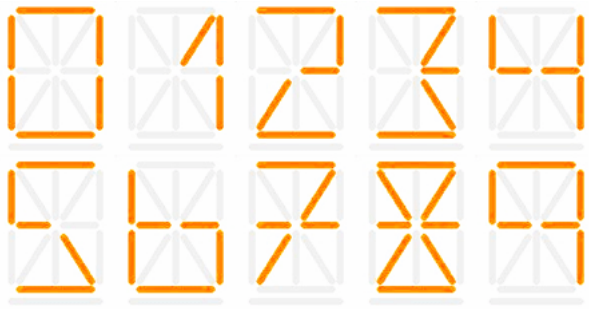
7.2.7 WITHER



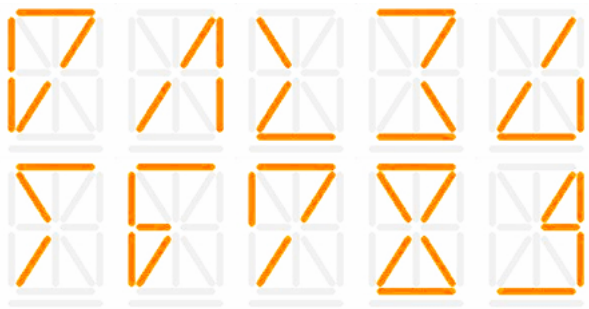
7.2.8 SKEWED



7.2.9 NICE 1

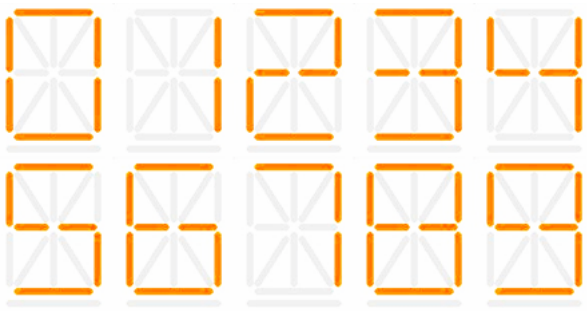


7.2.10 DECO 1



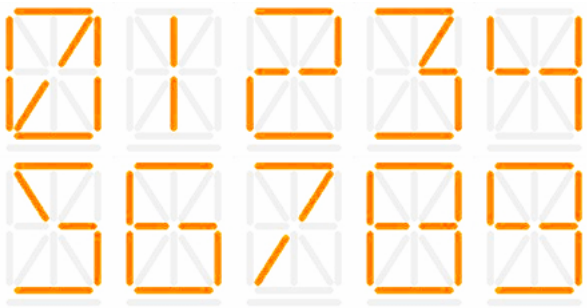
7.2.11 7 SEG

This is the standard 7-segment font found on many display devices over the years.



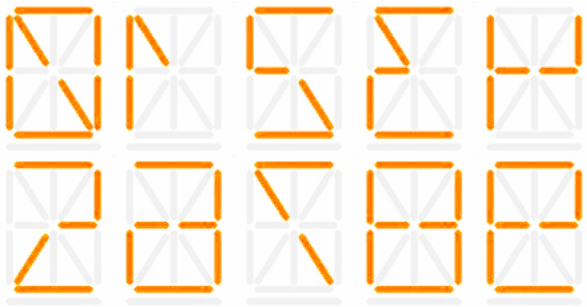
7.2.12 B7971

This is the font that these tubes used when they were in service as stock quote tickers.

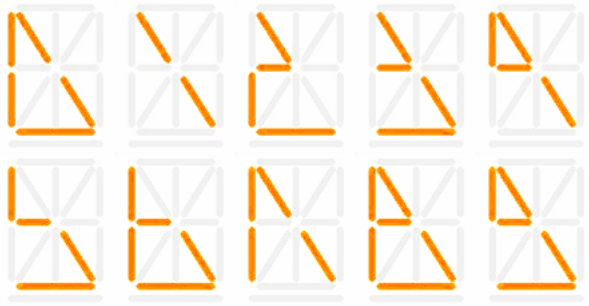


7.2.13 MIRROR

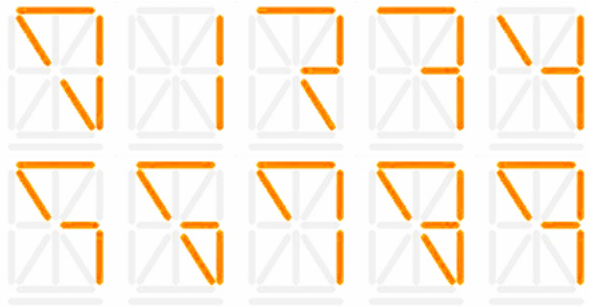
This is the STNDRD font, but in reverse.



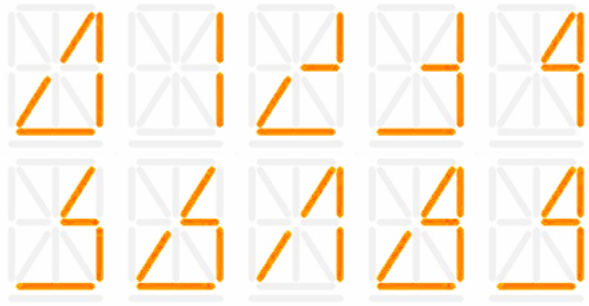
7.2.14 TILTNE



7.2.15 TILTSW

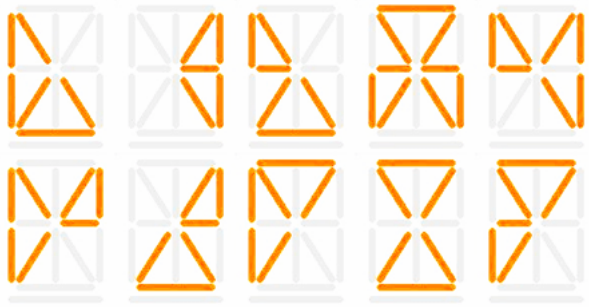


7.2.16 TILTNW

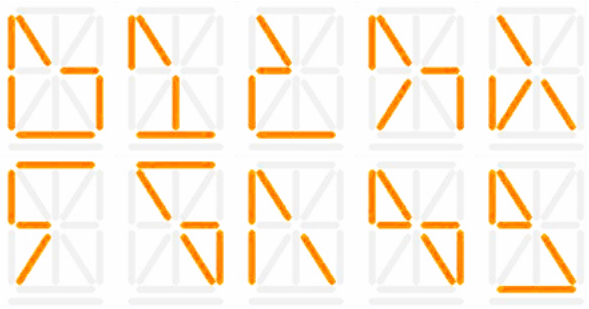


7.2.17 TILTSE

7.2.18 TRIANG



7.2.19 SKEWUP



8 Technology and History

The tubes used in this clock have a fascinating history and you can read more about them on the web. We've included a little background here to get you started.

8.1 Nixie tubes in general

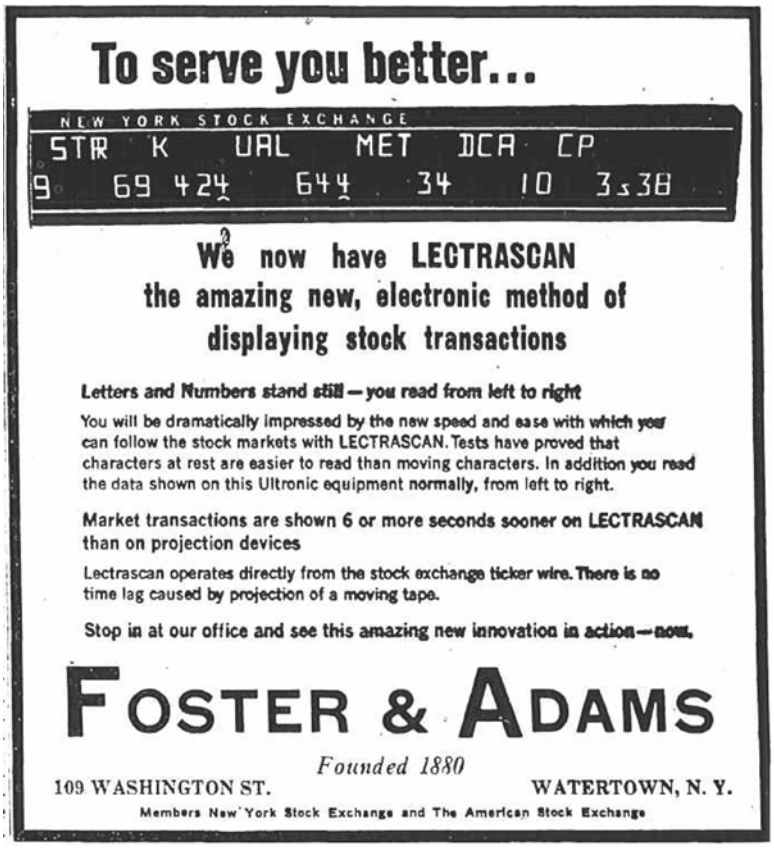
The display tubes are called "Nixie tubes", which were introduced in 1955. The basic method of operation is the same as of a neon light bulb (not the same as a neon sign), where applying electricity causes an orange glow to form around a wire inside the tube. Most tubes had wire elements in the shapes of the digits 0 through 9. The tubes in this clock are unusual in that they have 15 wire segments which can be combined to display letters as well as numbers. Despite being called tubes, Nixies do not contain the heating element that most other electron tubes use. Therefore, they run quite cool and efficiently.

After a number of years where various oddball technologies tried to take over from Nixie tubes, the first practical replacement came in the early 1970's with the LED (light emitting diode) display. LEDs were cheaper to manufacture, were much easier to connect to other electronics, and (later) came in a variety of colors. Depending on the desired use, other technologies also appeared around the same time - LCDs (liquid crystal displays) and VFDs (vacuum fluorescent displays). Some types of Nixie tubes continued to be sold as new until the mid-2000's, though they were actually older stock marked with later dates. For lots of information about every possible display technology, visit the web site of The Vintage Technology Association at http://www.decadecounter.com

8.2 The tubes in this clock

The tubes in this clock, which were manufactured from 1964-1968, were used in the "LECTRASCAN" stock ticker system found in major brokerage firms. When those systems were decommissioned, a few tubes were saved by collectors. 6 of them have now made their way into this clock for your enjoyment. As genuine antiques, they are quite rare and now cost over $100 each. They are among the largest Nixie tubes ever produced.

Figure 8–1 Newspaper advertisement from January, 1966



To serve you better...

NEW YORK STOCK EXCHANGE

STR	K	UAL	MET	DCA	CP
9	69 4 2 4	64 4	34	10	3 s 38

We now have LECTRASCAN the amazing new, electronic method of displaying stock transactions

Letters and Numbers stand still — you read from left to right

You will be dramatically impressed by the new speed and ease with which you can follow the stock markets with LECTRASCAN. Tests have proved that characters at rest are easier to read than moving characters. In addition you read the data shown on this Ultronic equipment normally, from left to right.

Market transactions are shown 6 or more seconds sooner on LECTRASCAN than on projection devices

Lectrascan operates directly from the stock exchange ticker wire. There is no time lag caused by projection of a moving tape.

Stop in at our office and see this amazing new innovation in action — now.

FOSTER & ADAMS

Founded 1880

109 WASHINGTON ST. WATERTOWN, N. Y.

Members New York Stock Exchange and The American Stock Exchange

Figure 8–2 A LECTRASCAN display frame with 48 tubes

8.3 Other technology

The rest of the components in the clock are the latest technology, unheard of in the 1960's. The CPU that runs this clock is more powerful in many ways than the fastest computer from that era. The components are microminiature (the technical term is SMT) and the programs that run the clock, RPTR-OLED, and the TimeLink receiver can be easily upgraded if needed (for example, to add new features).

9 "Geek" stuff

This chapter contains some information that most people won't care about, but if you're interested in learning some more technical details about the clock, read on...

9.1 The RPTR-OLED

The RPTR-OLED communicates with the clock on the license-free 2.4GHz radio band. These frequencies are shared with Wi-Fi networks, cordless phones, baby monitors, and even microwave ovens. The range of the RPTR-OLED will vary depending on which of these are nearby. The RPTR-OLED can be set to any of up to 128 channels (depending on country) to avoid interference with these other gadgets - see the configuration options section. In the United States, the allowed channels are 1 through 79.

Note: Use of the RPTR-OLED is optional. However, some clock features such as temperature, etc. reporting and the random word display function depend on a RPTR-OLED being present.

9.2 Environmental sensors

Displaying the temperature and optional barometric pressure / relative humidity sensor data is only possible when using the optional RPTR-OLED. This is because those sensors are located in the RPTR-OLED, not the clock itself.

9.3 Power-on segment test

A power-on test is available for testing the tubes and basic clock components such as the power supply and tube drivers. This test will operate even if major sections of the CPU board such as the radio module and clock chip are non-functional. While mostly of interest to people assembling the clock from kits, you may find it useful if your clock stops working or fails to operate normally when first installed for some reason. For normal tube testing, the SYSMNU / SEGTST menu option provides greater flexibility.

To activate the power-on segment test, press and hold the control knob while connecting the power cord to the clock. The tubes should cycle through a pattern of lighting one segment at a time, then the lower half of each colon and the AM/PM lamp, then the upper half of each colon, then all segments, colons and AM/PM lit, then all off. The pattern will repeat until power is disconnected. While in this test mode, the control knob is ignored. To exit, simply disconnect the power, wait a moment, and re-connect the power without pressing the control knob.

Note: The "power on" neon lamp and LEDs on the left side of the clock will always remain lit to show that power is still applied to the clock.

9.4 Service information

For information on servicing the clock, consult the MOD-6 Google Group at https://groups.google.com/group/mod-6_7971 or email badnixie@badnixie.com

A Default configuration options

This appendix lists the default configuration options that the clock ships with. They can be restored via the PROFLE / FACTRY menu option.

TIME	(set by GPS)
FONT	STNDRD
DATE	(set by GPS)
MONTH	(set by GPS)
YEAR	(set by GPS)
DIM	20
BRIGHT	90
LVLSET	15
DOT MD	BLINK
AM/PM	ON
XFADE	24
DATEMD	1 MIN
DATFMT	MMM DD
DATDLY	16
DATSCR	FADE
YEAR D	ON
DAY D	ON
12/24	12 HR
LZ SUP	ON
LDRTST	(display only)
FNTCAT	(display only)
TUBETM	(display only)
GPSMNU	
GPS MD	RF-LNK
TMZONE	-05:00
TWK16S	0
ULCK I	_ _ _ _ _ _
ULCKTM	120
SNCMSG	ON
SYSMNU	
QWKSEL	TM SET
UI TMR	30
DSPFNT	TIME F
SEGTST	(display only)

LED MD	RF RCV
SECNDS	ON
MSGS	ON
SCRLSP	1
SCRLXF	4
DSP 1	OFF
DSPORD	WMD
PWMVAL	28KHZ
ENCDIR	CW
RTCAGE	0
TMRMNU	
TMR MD	OFF
TM1OFF	00:00:00
TM1 ON	00:00:00
TM2OFF	00:00:00
TM2 ON	00:00:00
MON	TMR1
TUES	TMR1
WEDS	TMR1
THUR	TMR1
FRI	TMR1
SAT	TMR1
SUN	TMR1
PIR MD	OFF
PIRTIM	1M
QWKSET	TIMER
DSTMNU	
DST MD	ON
B TIME	02:00:00
B MNTH	MAR
B NTH	SECOND
B DAY	SUNDAY
E TIME	02:00:00
E MNTH	NOV
E NTH	FIRST
E DAY	SUNDAY
OFFSET	+01:00
LNKMNU	
RFCHAN	77
RFBAUD	250K

FOB MD	ON
ADDR	0
DIMMNU	
DATE	ON
SECNDS	SAME
DOT MD	SAME
LED MD	SAME
MET	ON
WORDS	ON
METMNU	
MET MD	1 MIN
F/C	FAHR
HG/MB	IN HG
BTREND	TEXT
S1 LBL	BLANK
T1 CAL	0
H1 CAL	0
B1 CAL	0
S2 LBL	-B-
T2 CAL	0
H2 CAL	0
B2 CAL	0
S3 LBL	-C-
T3 CAL	0
H3 CAL	0
B3 CAL	0
S4 LBL	-D-
T4 CAL	0
H4 CAL	0
B4 CAL	0
CLKSTA	OFF
H SUFF	RH
HEAR D	OFF
DSPDLY	20
WRDMNU	
WRD MD	1 MIN
NWORDS	1
LEXICN	ALL
DIRTY	OFF
EFFECT	RNDLET

LETDLY	16
SEGDLY	6
WRDDLY	32
BKENDS	OFF
PROFLE	CANCEL

B Operating multiple MOD-SIX clocks

The normal user environment has a single MOD-SIX clock and a single RPTR-OLED. In this situation, the pairing procedure described in Section 4.1.2 is sufficient to pair the clock with its RPTR-OLED. More complex arrangements are possible, however, and in those cases special care should be taken to avoid interference between the two (or more) MOD-SIX clocks. There are two ways of handling multiple clocks:

B.1 Multiple MOD-SIX clocks, multiple RPTR-OLEDs

This is probably the easiest solution. Each clock will have its own RPTR-OLED and will receive signals from only that RPTR-OLED. To operate in this mode, simply configure each clock on a different RF channel.

Note: We recommend leaving a gap of several channels between the channels you select for each RPTR-OLED / clock pair - for example, 79 and 82. This will eliminate the possibility of interference between the closely-spaced channels.

Since the RPTR-OLED will pair with the first clock it discovers during its scan, power up only the first clock and its RPTR-OLED, then pair the clock with its RPTR-OLED. Then power that clock and RPTR-OLED off and the next set of clock and RPTR-OLED on, and pair that clock with its RPTR-OLED. Repeat as needed. Once each clock has been paired with its own RPTR-OLED, all clocks and RPTR-OLEDs can be powered on and will operate normally, each clock receiving data from its individual RPTR-OLED.

B.2 Multiple MOD-SIX clocks, single RPTR-OLED

Another possible mode uses a single RPTR-OLED to provide the time and temperature, etc. information to a number of clocks simultaneously. This provides some cost savings as additional RPTR-OLEDs are not needed, but is limited to the distance at which each clock can receive a good signal from the RPTR-OLED. You may need to experiment with different locations for the RPTR-OLED to find the one that works best (or at all) for multiple clocks. Refer to the Section 4.2.17 for a useful diagnostic test to help find the best location for the RPTR-OLED, powering on *only one* clock at a time.

To operate in this mode, configure all clocks for the same RF channel and baud rate. Next, power off all but one of the clocks and pair the RPTR-OLED with that clock as usual. Once paired, you may power on the remaining clocks and they should all receive data from the one RPTR-OLED. Do not attempt to re-pair the RPTR-OLED with the additional clocks. It is not necessary and will usually be unsuccessful, as multiple clocks will try to respond simultaneously which may confuse the RPTR-OLED.

B.2.1 Notes on the single RPTR-OLED configuration

There are a number of things that it is important to be aware of when using multiple clocks with a single RPTR-OLED.

- If more than one clock is visible, they may update their display at slightly different intervals. The GPSMNU / TWK16S can be used to adjust the display of one or more clocks in 1/16 second increments.
- The RPTR-OLED sends several words to the clocks and the clocks use a random algorithm to select one of the words matching the configured criteria (for example, 4-letter, 6-letter, or both). With one RPTR-OLED providing words to all of the clocks, there is an increased chance of the same "random" word showing up on more than one clock at the same time.
- Since all clocks are receiving environmental data (temperature, humidity, barometric pressure, etc.) from a single RPTR-OLED, the data displayed on all of the clocks will be the data from where the RPTR-OLED is located, not the data where the clock is. If this becomes confusing, you can disable the environmental data display on any of the clocks via the METMNU / MET MD option.
- If there is a power failure or for some other reason multiple clocks are turned on at the same time, you may experience a "PING storm" where each clock reports to the others that it heard a wake-up packet from the other. The duration of this storm will vary depending on the number of clocks on the same RF channel. In tests with 5 clocks, the storm subsided in well under a minute and all clocks went back to displaying normally.

B.2.2 Using keyfobs with multiple clocks and a single RPTR-OLED

If you have multiple clocks all operating on the same LNKMNU / RFCHAN, you can still individually control them with separate keyfobs by setting each clock and keyfob to a different LNKMNU / ADDR. 8 addresses are available, numbered 0 through 7. A clock will only respond to a keyfob set to the same address, even if there are other keyfobs operating on the same RF channel. Other combinations of clocks and keyfobs are possible - you can set more than one clock to the same LNKMNU / RFCHAN and control them with a single keyfob.

C Configuring timer mode

The clock has two timers numbered 1 and 2 which control when the tubes are on and when they are off. This allows enhanced flexibility as various schedules can be configured. As the tubes are old and hard to obtain, some users may desire to have them turned off when there is nobody around to see them.

One possibility is to set the DIM menu option to zero and the LVLSET option to a value that reflects the actual lighting level when the room is occupied. For example, if a light is always lit in the room when it is in use, then (with an appropriate setting of LVLSET), the clock display will turn off when the room light is turned off. You can also use the left and right buttons on the optional keyfob to manually turn the clock display off and on. You may also set the TMRMNU / QWKSET option to DISP to perform the same action using the control knob on the clock.

The timers are used for more advanced situations as described in the sections below. In each of the examples, TMR MD should be set to ON to enable the timer function.

If you set the TMRMNU / QWKSET option to TIMER you can override the timer function by rotating the control knob on the clock or by using the up and down buttons on the optional keyfob. When you override the timer function in this manner the timer will resume at the next scheduled timer operation. In other words, it is a temporary override. You can disable timer operation by changing the TMR MD setting to OFF.

Notes: Brightness levels slowly ramp up and down to target levels, allowing time for the final brightness level to be reached.

The "power on" neon lamp and LEDs on the left side of the clock will always remain lit to show that power is still applied to the clock.

When setting the timers, if you have configured the clock for 12-hour display mode, make sure that you have selected the correct time by checking the AM/PM indicator light when setting the hours. The examples below all assume 24-hour display mode for simplicity.

These examples are just ideas to get you started and explain the timer concepts. Feel free to experiment with more sophisticated configurations.

C.1 Office use, 9 to 5 weekdays only

For this usage, set TM1OFF to 17:00:00 and TM1 ON to 09:00:00. Leave TM2OFF and TM2 ON at 00:00:00. Set the MON through FRI options to TMR1. Set the SAT and SUN options to NX OFF.

C.2 Office use, 9 to 5 weekdays, 10 to 2 Saturdays

This usage is a simple extension of the previous example. Set all options as in the previous example, except TM2OFF should be set to 14:00:00 and TM2 ON to 10:00:00. Set SAT to TMR 2.

C.3 Home use, off when at work

This example is similar to the first example, except that the ON / OFF times are reversed. Set TM1OFF to 08:30:00 (or whatever time you normally leave the house for work) and TM1 ON to 17:30:00 (or whatever time you return home). Set the MON through FRI options to TMR 1 and the SAT and SUN options to NX ON.

D A note about display sequence and overcrowding

It is possible to "overcrowd" the display to the extent that the time is only visible for a short period, if at all. When enabling display options the user should be mindful of the amount of time each item will be displayed. Items will be displayed in the following order (assuming the relevant options are enabled).

1 Random word 1
2 Random word 2
3 Random word 3
4 Random word 4
5 Random word 5
6 Sensor 1 temperature
7 Sensor 1 humidity
8 Sensor 1 barometric pressure
9 Sensor 1 barometric trend
10 Sensor 2 temperature
11 Sensor 2 humidity
12 Sensor 2 barometric pressure
13 Sensor 2 barometric trend
14 Sensor 3 temperature
15 Sensor 3 humidity
16 Sensor 3 barometric pressure
17 Sensor 3 barometric trend
18 Sensor 4 temperature
19 Sensor 4 humidity
20 Sensor 4 barometric pressure
21 Sensor 4 barometric trend
22 Day name
23 Month and day
24 Year

While it can be tempting to "turn everything on" to see all of the interesting data that is displayed, it can become somewhat overwhelming to the casual observer (who probably just wants to know what time it is). Experiment with enabling options selectively in order to see what works best for you. Also, the various displays can be suppressed when the clock is in dim mode (see DIMMNU) to avoid distraction in low-light / nighttime environments.

The SYSMNU / DSP 1 option can be used to limit the amount of information displayed during a particular display interval. In conjunction with SYSMNU / DSPORD it controls the priority of the different message groups - date, metrology (sensor), and random word(s).

Note: If word display is enabled and any of the random options for words are selected, it is not possible to determine exactly how long a complete display cycle will take.

§ *Terminat hora diem, terminat auctor opus*