



## Wireless Clock System

### Technical Guide



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**(Patents Pending)**

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## Overview

The DuraTime wireless clock system is specifically designed for applications where precision and reliability are of great importance. In most cases, external time updates are not required. The RC100 includes an oven controlled oscillator with an accuracy of one second in 20 years (2 Parts per Billion). The RC100 is factory calibrated with the U.S. Atomic clock. It will maintain time during shipping and power outages. If greater accuracy is required, then external time updates are required. However, the master clock is more reliable when operating solely from the internal high precision oscillator.

If external time updates are desired, the RC100 includes an Ethernet interface to obtain NTP time updates. An optional wireless GPS receiver is also available.

All clocks in the system will not only display the same time, but the true legal time. Any combination of clock shapes, style or size may be synchronized. DuraTime clocks are designed for organizations that require reliable and accurate synchronized time.

The DuraTime multi-path wireless clock system is highly reliable. The system operates on the license-free 2.4 GHz Industrial, Scientific and Medical band. Spread Spectrum radios are used to enhance signal coverage, along with AES 128 bit encryption to enhance security and reliability. Multi-path wireless communications are used to propagate the time signal throughout any size facility. The failure of any single clock will not affect the remaining clocks in the system. Supervision is available to automatically check the operation of all wireless devices on the system.

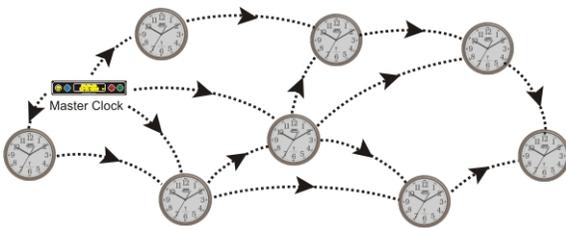
The system can be configured to use multiple, simultaneous time sources. For example, NTP, GPS and the internal high precision oscillator time sources can all be used at the same time. The standard RC100 is accurate to about 1 second in 20 years without NTP or GPS time corrections. An optional Rubidium atomic oscillator is available that eliminates the need for NTP or GPS updates and maintains split accuracy for the life of the system. Multiple master clocks may be used so that if one master clock is down or loses sync, the system automatically continues to function normally from the secondary master clock. DuraTime digital clocks include an internal battery that will maintain the time for up to 10 years. DuraTime battery powered clocks utilize a redundant parallel battery configuration that allows the clock to function even if a battery fails. No other system on the markets offers this level of reliability and ease of operation.

Each master clock may be configured for a variety of time zone and Daylight Saving Rules, including UTC (Zulu) Time, Any World Time Zone, Half-hour time zones, Enable or Disable Daylight Saving Time, and selectable 12 or 24 hour display formats with digital intensity control on digital clocks.

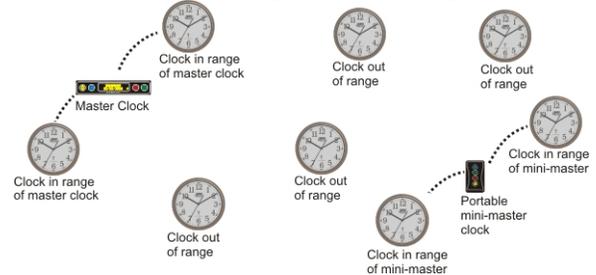
## DuraTime Multi-path Wireless Communications

The examples listed on these pages are simplified for communicating system concepts. The number of actual clocks in a system could easily number in the thousands, either densely located, or spread over a wide area, with complete coordination of all communications.

### Signal Paths of an Active Network



### Installing Battery powered Analog Clocks

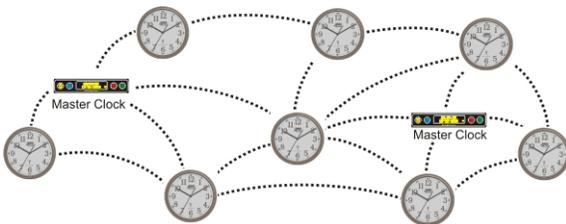


When the wireless clock network is active, all clocks are within range of one or more other clocks. Each clock receives and retransmits time signals.

The wireless network can also be configured as a continuously active network by adding repeaters and other non-battery powered devices. Simply add radio devices in areas where the signal is absent. A mini-master device can be used as a signal monitor to determine where the network is active or where additional wireless devices are needed to extend the network. Once the continuously active network is configured, the mini-master is no longer required to install or replace battery powered analog clocks.

Battery powered analog clocks need to conserve power as much as possible, so the internal radio is put to sleep most of the time. The clock awakens the radio for ten seconds, seven times a day to obtain and propagate the time signal. During this on period, the clocks instantly form a wireless network, transferring data as needed and updating the time display. A hand-held mini-master clock is used to provide a time signal when the wireless clock network is not active. The dashed lines indicate the radio range of the active transmitters. The mini-master provides a time signal for the clock to reference when the batteries are installed. Once the newly installed clock receives a signal from the mini-master, it is synchronized with the network and the mini-master is no longer required.

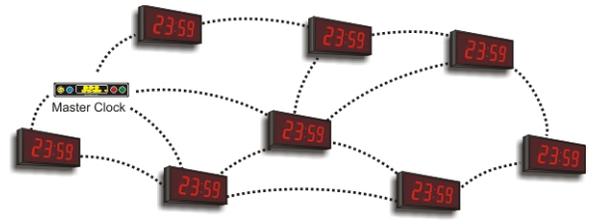
### Multiple-redundant Master Clocks



Multiple master clocks may be used to increase system reliability. Each master clock can obtain time updates from multiple sources, simultaneously.

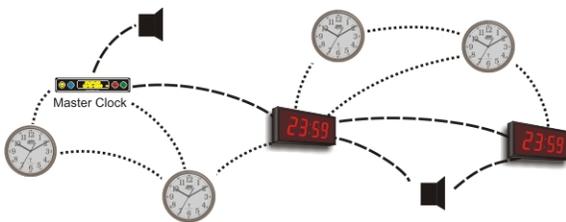
The master clocks are designed to nest on top of one another. Or, they may be spread around the facility. Master clocks automatically communicate with one another to determine which master clock shall be actively transmitting.

### Continuously Active Network using Digital Clocks



Digital clocks are externally powered and are continuously available to form a network. Time is distributed to all clocks every other second or 43,200 times per day. The mini-master clock can be used as a signal detector to determine if the area to be covered is complete during and after installation. Externally powered analog wall clocks and wall repeaters can also be used to form a continuously active network.

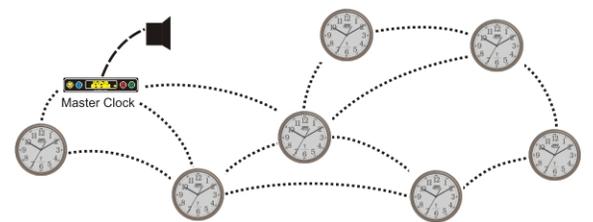
### Continuously Active Network with Digital and Analog Clocks



In a hybrid system of externally powered and battery powered clocks, the network is continuously active between digital clocks as indicated by the heavy dashed lines. Network communications between battery powered analog clocks is available for ten seconds, seven times per day.

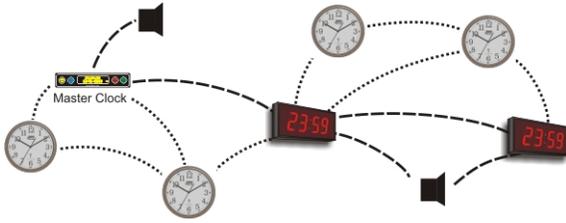
The mini-master clock is not required to install the analog clocks that are within range of the mains powered wireless devices. The mini-master clock can be used as a signal detector to determine if a continuously active network signal is present. If not, simply activate the time transmissions of the mini-master before installing battery powered clocks.

### Alarm/Tone Generator with an Idle Wireless Network



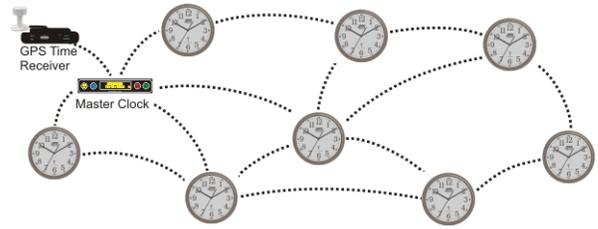
The wireless alarm/tone generator must be located within 150 feet of an actively transmitting component of the network, such as the master clock. Open areas such as warehouse space or manufacturing facilities may extend this range up to 330 feet.

### Alarm/Tone Generator with a Partially Active Network



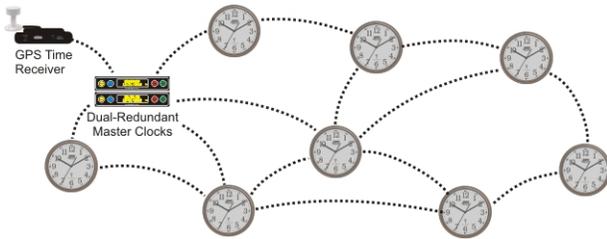
Multiple wireless alarm/tone generators may be deployed. Each alarm/tone generator must be located with 150 feet of a continuously active component of the network. Open areas such as warehouse space or manufacturing facilities may extend this range up to 330 feet.

### Wireless GPS Time Receiver



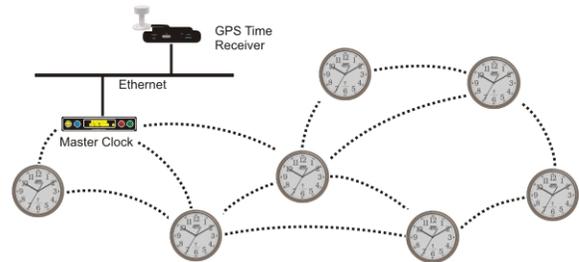
The RC160 wireless GPS receiver will provide time updates to one or more master clocks. The GPS translator must be located within 150 feet of one or more RC100 master clocks (330 feet in open space construction). Each master clock then transmits time packets to all clocks on the network. In addition, each master clock can obtain time from public or private time servers on the network to backup the GPS receiver. Another GPS time receiver model is able to send time updates over the computer network to one or more master clocks. Set the GPS receiver and master clock on different channels.

### Wireless GPS Time Receiver



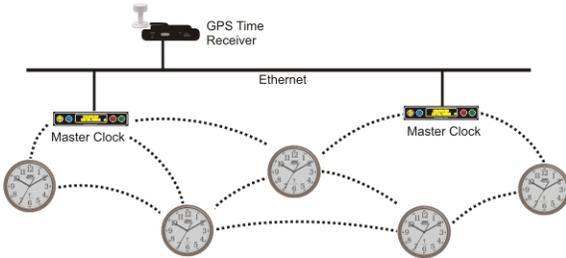
Above is an example of a dual-redundant master clock system receiving time updates from a single wireless GPS receiver. In addition to the time updates from the GPS receiver, each master clock is capable of receiving redundant time updates from local or public NTP time servers. The master clocks can be stacked on top of one another, or they may be located in different parts of the building or campus. Set each master clock and GPS receiver on different channels.

### Ethernet GPS Time Receiver



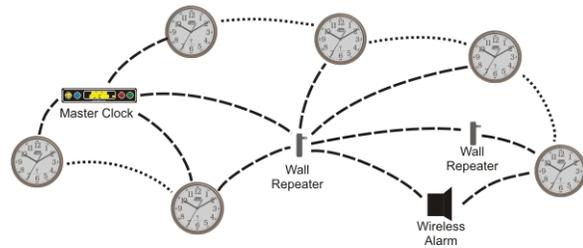
The RC165 Ethernet GPS receiver will provide time updates to master clocks over the customer provided Ethernet computer network. In addition to receiving time updates from the GPS receiver, the RC100 master clock is capable of receiving redundant time updates from local or public NTP time servers.

### Ethernet GPS Time Receiver with Redundant Masters



The RC165 Ethernet GPS receiver is capable of providing time updates to multiple master clocks located on the same subnet. Master clocks located on different subnets should use a local or public NTP time server to obtain time updates. The RC100 master clock is fully capable of obtaining time updates using NTP. Set the master clocks on different channels.

### Using Wall Repeaters to form a Continuously Active Network



Inexpensive wall repeaters are available to provide a continuously active wireless network. This allows wireless relays, tone generators and GPS receivers to be located anywhere in the facility where the active network is available. The wall repeaters include an LED activity indicator to confirm that the network is active. Repeaters are also useful to fill gaps in coverage when wireless devices are spread far apart. Wall repeaters and analog clocks repeat all radio channels.

## DuraTime Features and Options

The DuraTime Wireless Synchronized Clock System offers flexibility and reliability for demanding time display applications. This clock system will perform flawlessly for any size facility, or campus.

### Master Clock Package Contents

1. DuraTime RC100 Master Clock
2. AC Power Adapter with plugs for North America, UK type, Europe and Australia
3. 10 feet (15M) of Cat-5 network cable
4. Quick Start Guide
5. DuraTime User Manual

### Standard Features

1. 100% digital radio communications
2. Oven controlled oscillator accurate to 1 second in 20 years (2 parts per billion)
3. Simple installation. No system configuration required. Just insert batteries and hang on the wall.
4. Coverage for any size facility
5. Self-healing network
6. Multiple master clocks are supported for increased reliability
7. All master and secondary clocks throughout the system are synchronized to the U.S. Atomic Clock.
8. AES 128 bit encryption, providing secure and reliable communications
9. Uses the standard 2.4 GHz ISM (Industrial, Scientific and Medical) band for global compatibility
10. Master clock with LED display for time and configuration
11. Secondary clocks continue to maintain time in the absence of a time signal.
12. No FCC License or additional government authorization required. Approved for Government installations.
13. Spread Spectrum technology (DSSS) utilized, developed for the U.S. Government.
14. Electrical and/or network wiring is eliminated when using battery powered wall clocks.
15. Battery powered analog wall clocks will operate five years or longer between battery changes.
16. Daylight Saving rules can be changed at any time.
17. Master clock and Digital Clocks include a 20 year supper capacitor to maintain time during a power outage. No batteries are used or needed in master clocks or LED digital secondary clocks.
18. Master clocks include an alarm relay output for one zone
19. 999 total alarm settings
20. 12 alarm zones
21. Alarm schedule activation by date range
22. Variable duration for each alarm setting
23. Select audio, tone or relay closure for alarm output
24. Over 70 audio alarm recordings included with optional wireless alarm interface
25. Enable/Disable auto switching between daylight and standard time
26. ABS IRU enclosure for either desk top or rack mount installation.

### Optional Features

1. Rubidium Atomic Clock - split second accurate for the life of the system (no computer network required)
2. Wireless Relay / Audio Player for connecting to bells or paging systems
3. Wireless GPS receiver – no wiring required between the GPS receiver and master clock
4. Wireless serial interface for special communications applications
5. Wireless repeaters to bridge coverage gaps or to provide a continuously available network
6. RC150 Mini-Master Clock ( includes two “AA” Lithium batteries)

### General Specifications:

#### **DuraTime Radios**

Frequency	2405 to 2480 MHz
Protocol	802.15.4, Proprietary Mesh Network
Operating Mode	ISM
Modulation	Direct Sequence, Spread Spectrum, Digital
Data Speed	250 Kbps
Operating Voltage	2.1 to 3.3 Volts
Output Power	+20 dBm
Rx Sensitivity	-97 dBm
Range	3,000 + feet (900 meters)
Operating Temperature	-40C to +85C
Regulatory Certification	FCC-ID W7Z-ZIC2410P2, IC 8254A-ZIC24102, CE
Digital Codes Available	65,535
Antenna Type	Inverted-F PCB antenna, no external access
RF Channels	16
External controls	None
Rx Current	30 mA
Tx Current	200 mA
Collision Avoidance	Yes
Channel Busy Detection	Yes

## **RC100 Master Clock**

### **Environment:**

-32 degrees F to 120 degrees F, Humidity: 0% to 95% non-condensing

### **Internal Time Battery Backup:**

10 year NiMH rechargeable battery – uses one millionth of a watt in standby mode

### **Clock Accuracy:**

The RC100 incorporates an ultra-high precision oven controlled quartz oscillator (OCXO) that is accurate to 2 parts per billion, or about one second in 20 years without NTP. NTP provides an accuracy up to + or – 0.1 second per year using an NTP and/or GPS time source. An optional Rubidium atomic clock is available for the rack mounted RC100 that provides split second accuracy for the life of the system without the need for NTP or GPS time corrections.

### **Construction:**

ABS 1RU cabinet allows the internal antenna to communicate with any number of secondary devices. The cabinet may either sit on a shelf or mounted in a standard 19” equipment rack.

### **Power Requirements:**

7-12 volts DC, 2 amps

AC adapter input 100-240 VAC, 0.8A, 47-63 Hz (FCC, UL, CE CB, GC)

## **RC60 Battery Powered Analog Clock Movement**

### **Environment:**

32 degrees F to 120 degrees F, Humidity: 0% to 95% non-condensing

### **Clock Accuracy:**

Nominal accuracy provided is + or – one second when updated twice daily.

### **Construction:**

ABS plastic cabinet allows the internal antenna to communicate with any number of secondary devices.

### **Power Requirements:**

Four LR6 (AA type) Alkaline or Lithium primary batteries

## Planning

All DuraTime wireless devices receive and re-transmit time data to other devices. This includes master clocks, analog clocks, digital clocks, alarm interfaces, repeaters and sensors. This method of repeating data allows coverage of any size of facility or campus. The rule-of-thumb for the placement of wireless devices is to locate them no further than 150 feet (45m) apart for areas with many wall partitions, such as offices, dormitories and hospitals. For open areas such as a manufacturing floor or warehouse, locate wireless devices no more than 330 feet (100m) apart. If wireless devices must be located further apart or areas isolated from radio signals need to be penetrated, then repeaters or other DuraTime wireless devices may be installed to bridge large distances or penetrate difficult to reach areas.

## Installation

### **Master Clock Installation**

The master clock is accurate to about one second in 20 years, so NTP or GPS is not required for time updates. For best results, centrally locate the master clock(s) in the facility.

1. Connect the network cable into the back of the master clock.
2. Plug the low voltage cable from the AC adapter into the back of the master clock.
3. Plug the AC adapter into a wall outlet.

The master clock will attempt to automatically register with the computer network using DHCP. If a network connection is successful, it will then attempt to acquire network time from public time servers using NTP (Network Time Protocol).

If DHCP is not available, the master clock's network interface must be configured with fixed IP address information. If an internal or other time server is to be used in place of public time servers, then this too will need to be changed in the network interface. See the Ethernet Communications section later in the manual for more information about configuring the Ethernet interface.

When the master clock receives a time update from an external time server or the internal high precision oscillator, an H, E or G sync indicator will appear the right side of the LED display. An "H" indicates the time source is the internal high precision oscillator, "E" indicates NTP time source, "G" indicates a GPS time source. When multiple time sources are used, the indicator will identify the last time source used.

The master clock incorporates a high precision oven controlled quartz oscillator accurate to 1 second in 20 years, so the clock will maintain the time for an extended period without external time updates.

An optional GPS receiver is available for the master clock. This receiver sends the time received from the GPS satellites wirelessly to the master clock. The GPS receiver can be used in addition to NTP time for a redundant time source.

**Configuring the Time Zone Offset**

If the time displayed is incorrect after the synchronization indicator appears, then time zone rules may require reconfiguration. Mode 21-1 determines the time zone offset from universal coordinated time (UTC).

**Configuring Daylight Saving Rules**

If Daylight Saving Time is not observed in your area, set Mode 24-1 = 0.

The RC100 Master Clock offers two methods of implementing automatic switching between Standard and Daylight Saving Time, rule based and fixed day-of-the-year. The rule based method is preferred because it provides the correct day of the year regardless of whether it's a leap year or not. The rule method is configured by entering numeric values that represent the specific rule for your area. Mode 45-20 (switch to Daylight Saving Time) and Mode 45-21 (switch to Standard Time) are used to store the Daylight Saving Rule.

The format is MMRD, where MM = month (1-12), R = instance of the select day of the week (1-5 5=last instance), D = day of the week (1-7), where 1=Monday and 7=Sunday. For example, 357 = the last Sunday in March, and 1117 = the First Sunday in November.

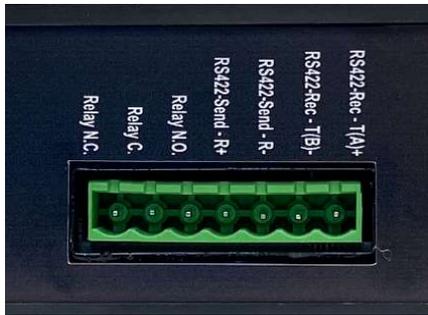
If the value >2000 then the right two digits represent the day of the month. The left two digits, minus 20, equal the month. For example, March 15th = 2315, April 1st = 2401.

To configure a fixed day of the year (example, 15<sup>th</sup> of the month), then set the modes to 0, and enter the day of the year to switch into Mode 52-1 (switch to Daylight Saving Time) and Mode 52-2 (switch to Standard Time).

For a list of Daylight Saving Time rules for your area, go to [www.timeanddate.com](http://www.timeanddate.com).



Connections on the back of the master clock.



Alarm relay connections along with RS422 connections.

The DuraTime RC100 master clock includes connections for power, alarm relay and Ethernet. The alarm relay includes 10 Amp contacts. Larger loads should make use of a slaved relay.

There are two primary network types: **Periodically Active** and **Continuously Active**.

**Periodically Active Wireless Network** - A clock system comprised of battery powered secondary clocks is an example of a periodically active network. The network is only active for 10 seconds, twice daily at 02:00:40 and 04:00:40. The optional mini-master is helpful when installing battery powered analog clocks, because the wireless network is idle most of the time. The periodically active network requires the least amount of equipment and therefore is the most economical. The mini-master clock is helpful when installing battery power analog clocks in a periodically active network.

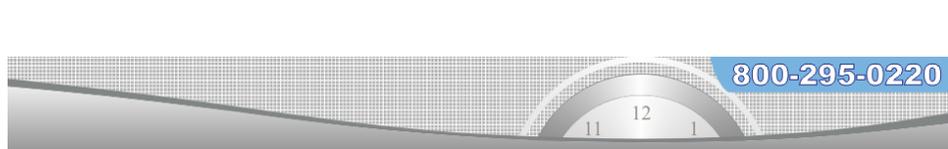
**Continuously Active Wireless Network** - A system comprised of externally powered digital or analog clocks, or any other DuraTime device that's externally powered is an example of a continuously active network. Each clock is always active, receiving and retransmitting data. In this type of network, the mini-master is unnecessary when installing battery powered analog clocks. The clock will receive a time update as soon as it is powered because the network is always active. The advantage of the continuously active network is that the time signal is always available when installing or replacing battery powered clocks. No mini-master is required. The downside is there may be some additional equipment required to repeat the signal. However, given the long range of repeaters, the additional equipment would be minimal.

A continuously active wireless network is very easy to install before installing secondary devices. First install the master transmitter(s) as described above. Then, place the mini-master tool in receive mode by momentarily pressing the yellow On/Off button to turn the unit on. Then momentarily press the blue Receive Only button. The indicator light should begin blinking every other second as it receives time broadcasts from the master clock(s). Wall repeaters and analog clocks repeat all radio channels.

Next, walk down hallways or around the area until the signal light begins to blink irregularly, indicating a weak signal. At this point plug in a wireless wall repeater into an outlet somewhere between the poor signal point and the master clock. A light on the wall repeater indicates power and blinks to indicate radio activity. Alternatively, any DuraTime externally powered device such as an AC powered analog clock, digital clock, wireless relay/audio player/tone generator, wireless GPS receiver, or serial interface can be used in place of a wall repeater. It is highly



RC140 Wall Repeater



recommended to plug the wall repeater into an outlet located high on the wall to prevent accidental damage or tampering. Dropped ceiling repeaters are also available.

Be sure to secure the wall repeater to the electrical outlet using the screw hole provided in the repeater housing. The repeater in the photo is typical for the USA and Canada. Repeaters for other countries typically consist of a wall or shelf mounted enclosure with a separate AC power adapter with the appropriate plug.

Continue the signal survey until the mini-master indicates full coverage throughout the facility. A redundant system using multiple master clocks can be used in a multi-building campus to provide full coverage. Once full coverage is verified, the mini-master is no longer needed. Battery powered analog clocks can be installed anywhere in the coverage area.

### **Analog Clock Installation in a Periodically Active Wireless Network**

The master clock transmits time updates every other second (43,200 times per day). However, analog wall clocks only turn their radios on for ten seconds, twice per day at 02:00:40 and 04:00:40. This means that a system-wide network is only formed during the time the analog clocks have their radios enabled.

There are two recommended methods of initializing analog clocks. For small systems, the clocks should be brought within 150 feet of the operating master clock. Insert batteries into the clock's battery holder. The clock will first move the hands 12 hours to obtain a known reference point. The clock will then receive and process the time and begin moving the hands in about four minutes. Once the hands start moving to the correct time, the clock can be installed in the desired location.

For large system, a mini-master clock is recommended for installer(s) to carry while installing clocks. This device allows inserting the batteries into the clocks at the location where the clock will be installed. Once the clock has moved the hands to 12:00, the clock no longer needs the presence of the mini-master clock. At this point, the installer can move on to install the next clock.

Alternatively, repeaters, digital clocks, wireless relays and other externally powered devices can be used to form a continuously active network with full facility coverage. In this case, analog clocks can be installed without the need to use the mini-master clock.

### **DuraTime RC150 Mini-Master Clock**

The optional RC150 Mini-Master clock is a hand-held unit used to install battery powered clocks when a signal from the master clock is unavailable. Because battery powered clocks only power on briefly seven times per day, a time signal may not be available in a particular area. The RC150 Mini-Master clock provides a constant time signal so that clocks may be installed regardless if the wireless network is active or not.

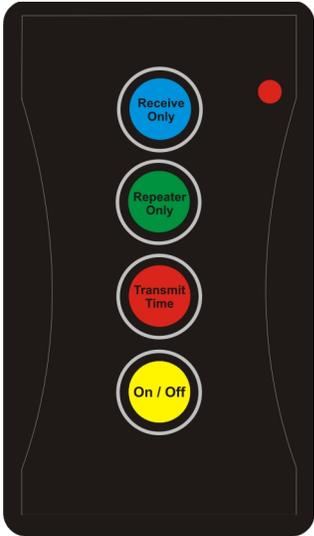
The RC150 Mini-Master is a high precision synchronized master clock, incorporating a temperature compensated quartz oscillator, multi-path radio transceiver and a 10 year battery to maintain the internal time.

**Mini-Master Clock Operation**

Press the yellow On/Off button to power on the unit. The LED will flash twice per second. This indicates the unit is in repeater only mode. It does not broadcast the time in this mode. It only repeats broadcasts it receives.

To re-synchronize the RC150 mini-master with the RC100 master clock, bring the mini-master unit within 150 feet of the master clock. Then momentarily press the blue Receive Only button to place the unit into receive mode. The LED should blink every other second as it receives broadcasts from the master clock. Press the Receive Only button again to receive and store the time transmission into the mini-master device. The LED will flicker momentarily if the time is successfully stored in the unit.

To start time broadcasting using the mini-master, press the red Transmit Time button. The LED will double flash every second.



RC150 Mini-Master

To receive and repeat all broadcasts, without transmitting time stored in the mini-master, press the green Repeater Only button.

Press the On/Off button to turn the unit off. The unit will automatically turn off after eight hours of operation. The unit is powered by 2 x AA batteries.

Once the RC150 Mini-Master is placed in broadcast mode, it can be carried along while installing battery powered clocks.

Install clocks closest to the transmitter(s) first, working away from the master clock.

Multiple master clocks, with overlapping coverage is acceptable, providing redundant time synchronization.

This is particularly important during installation and battery replacement. If the analog clock is out of radio signal range, it will not move to the correct time after batteries are installed. There are two ways to be sure a signal is present during battery installation. Either locate the clock with 150 feet of the master clock, or turn on a hand-held mini-master clock in the immediate vicinity of the analog clock. Then, insert the batteries into the analog clock and wait a few minutes for the clock to receive the time signal and begin moving the hands to the correct time. Go ahead and hang the clock on the wall. You do not have to wait for the hands to complete the move to the correct time. Analog clocks receive and repeat all radio transmissions to propagate the signal throughout the facility.

To change the channel of the mini-master clock, press the On/Off button to power the unit on. Then simultaneously press the Repeater Only and Transmit Time buttons, then release. The indicator light will flicker momentarily and then go out. Next, press the Transmit Time button equal to the desired channel number. Bypassing the Transmit Time button sets the channel to zero (default). The indicator light will flash to acknowledge each button press. Next, press the On/Off button to save the channel setting. The unit should immediately start operating in repeater mode on the new channel. Setting the channel to 15 will cause the device to transmit and receive on all channels. Repeaters and analog clocks always transmit and receive on all channels.

Setting the mini-master channel to 16 will cause it to immediately start broadcasting simulated GPS packets. The GPS packets will be off by the time zone offset and will not represent the correct hour; although the minutes and seconds should normally be correct. Any further button selections will cancel simulated GPS mode.

### **Digital Clock Installation**

If the clock system is comprised entirely of digital clocks, the digital clock will receive and move to the correct time (if it isn't already there) as soon as power is applied. However, if the clock network is comprised of a combination of digital and analog clocks, the complete network may not be active until the analog clocks enable their respective radios. This occurs twice per day at 02:00 and 04:00. Digital clocks within range of the master clock or repeaters will move to the correct time as soon as power is applied.

The Mini-Master clock can be used as a signal monitor to determine wireless coverage. First, turn the unit on by pressing the yellow On/Off button. Then, press the blue Receive Only button. The mini-master indicator light will blink with each time transmission from the master clock. The master clock normally transmits every other second.

Digital clocks receive and repeat all radio transmissions to propagate the signal throughout the facility.

The digital clocks are constructed using a sturdy aluminum frame with an anti-glare acrylic lens and ABS back plate. Various mounting methods are available. The standard mounting method consists of saw tooth hangers located on the back of the clock. Simply drive the appropriate number of screws into the wall and hang the clock on the screws. Secure eyelet attachments are also available where a more secure mount is required.

### **Wireless Relay / Audio Player / Tone Generator Installation**

While the master clock includes alarm relay connections, the location of the alarm devices may be some distance from the master clock. In this case, wireless alarm relays are available. Wireless relays should be located within 150 feet of continuously active network transmissions.

The wireless relay / tone generator includes a configuration dip switch.

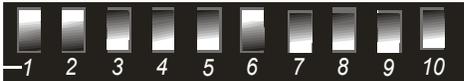
Switch position 1 sets the audio output, up=high (1 volt P-P), down=low (0.5 volt P-P).

Switch position 2 sets the device function (up=audio player w/ relay following, down=timed relay).

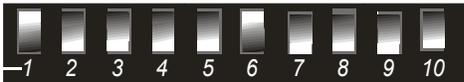
Switch positions 3-6 sets the alarm zone number (binary 1-12).

Switch positions 7-10 sets the radio channel number (binary 0-15). Setting the channel to 15 will cause the device to transmit and receive on all channels.

When switch position 2 is in the up position, the relay will activate as long as audio is playing. When the switch is down position, the relay will use the timed values indicated in the drop down box of the Windows alarm configuration program. In addition to the time relay values, the relay can be configured to remain on or off indefinitely.



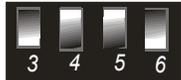
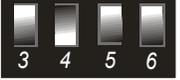
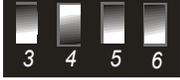
DIP switch setting (default) for high volume, audio player active, alarm zone 1, radio channel 0



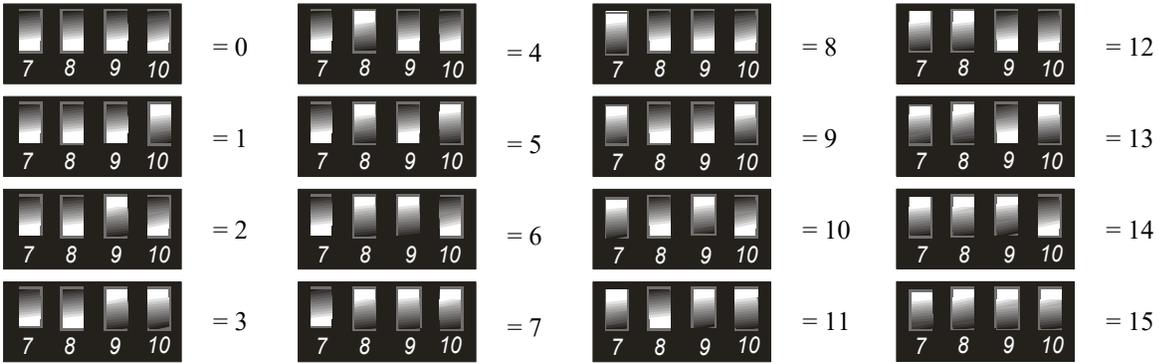
DIP switch setting for audio disabled with timed relay active, alarm zone 1, radio channel 0

Binary value DIP switch settings – use the following tables to configure the switches for the zone and channel numbers.

The zone number switches on a wireless relay are numbered 3-6

	= 1		= 5		= 9
	= 2		= 6		= 10
	= 3		= 7		= 11
	= 4		= 8		= 12

The channel switches are numbered 7-10.



The relay output of the master clock is always a timed or steady state, and does not follow any audio play, or zones.

An internal speaker is available when the device is in audio player mode.

The Wireless Relay / Audio Player includes over 70 pre-recorded tones, chimes, buzzers and bells. Also included are various Westminster clock chimes. These chimes can be configured as a campus wide clock chime system. For best results, use only SanDisk brand memory cards.

The wireless alarm relay includes 10 Amp contacts. Larger loads should make use of a slaved relay.

Wireless Relay modules receive and repeat all radio transmissions to propagate the signal throughout the facility.

The DuraTime control program for Windows is available to configure and control alarm settings.

Setting the channel to 15 will cause the device to transmit on all channels, but reception is disabled. Repeaters and analog clocks always transmit and receive on channels 0-14.

## Operation

The DuraTime master clock obtains time updates from local or public time servers, and/or from the optional GPS receiver. The time received is used to update the master clock’s internal temperature compensated quartz oscillator. The internal clock is backed up using a 10 year Lithium battery to prevent time disruptions due to power outages. All master clock configuration parameters are stored in non-volatile memory and are unaffected by power outages. Any number of master clocks may be used for improved system reliability.

The master clock transmits time updates using a 2.4 GHz Direct Sequence, Spread Spectrum digital radio. All data transmitted is encrypted using AES-128 bit data encryption for security and reliability. The RC100 master clock broadcasts time updates every other second (43,200 times per day).

### Adjusting the time

The clock is factory synchronized with the atomic clock and normally does not require further adjustment. If adjustment is required, then it is recommended that NTP or GPS be used to set the time. The master clock can be manually adjusted with the Up and Down buttons. These buttons are normally disabled. Press both buttons at the same time to enable. When the Up or Down buttons are pressed, the minute will change and the seconds will reset to zero. To set the clock to the exact second, use known accurate time reference. Change the master clock at exactly the top of the minute.



Above is a dual-redundant master clock configuration with control buttons and LED displays. The primary master clock is on top as indicated by the “P” on the display. It is actively broadcasting time packets as indicated by a “T”. The secondary master clock as indicated by the “S” on the display is in standby mode as indicated by the absence of a “T”. The secondary master clock will automatically begin transmitting if the primary fails to transmit time packets or loses GPS or NTP sync. Both clocks are in sync with the atomic clock as indicated by the “H” character, indicating the internal high precision oscillator is being used. Other valid sync indicators are “G” for GPS and “E” for Ethernet NTP. Transmissions to wireless alarm devices will only be sent if there is a “T” displayed. The absence of a “P” or “S” indicates the master clock is configured for single master clock operation. It will always transmit in this configuration, regardless of the presence of other master clocks or sync reception.

When dual redundant master clocks are utilized, the secondary master clock will automatically begin broadcasting time if the primary master clock loses GPS or NTP sync, or stop sending time packets. When the primary master clock problem is corrected, it will resume broadcasting time and the secondary master clock will cease sending time. Both master clocks will receive and use time GPS or NTP time updates whether they are broadcasting time or not. A “T” on the display indicates that it is actively broadcasting time packets. For more information about configuring dual redundant master clocks, see Mode 32-69 in the Master Clock Configuration Menu section of this manual. In dual-redundant master clock configurations, a “P” on the right side of the display indicates that it’s configured as a primary master clock. An “S” indicates it’s configured as a secondary master clock. The absence of a “P” or “S” indicates the master clock is

configured for single master clock operation. It will always transmit in this configuration, regardless of the presence of other master clocks or sync reception.

By default, the LED display will cycle through several screens to display different information. Momentarily pressing the blue TC button will display various other formats.



Six digit time



Eight digit date



This screen indicates whether the clock is a primary or secondary master clock



The screen indicates how the clock is synchronized, HP (high precision oscillator), GPS or Network time.



This screen indicates which alarm schedule is active.

By default, the clock cycles through the above display formats. A different display format can be selected by momentarily pressing the blue TC buttons. The following fixed display shows the

time and includes indicators for sync source and primary or secondary status. A “T” will display on the primary clock that is actively transmitting.



Another available display format includes four digit time following by status indicators. A “T” will display on the primary clock that is actively transmitting.



When a slave clock receives a time update, it immediately repeats the signal to all other clocks within range. It also uses the time packet to update its internal clock, which is used to update the display.

All remaining slave clocks receive and repeat the wireless data as needed, forming a multi-path network. This multi-path network provides radio signal coverage for virtually any size facility. Furthermore, the failure of any single clock will have no effect on the clock system as clock communications are automatically routed around the failure.

If the distance between clocks is so great that there is a gap in the network, repeaters are available to easily bridge the gap. Repeaters can also be used to form a wireless network that is continuously active.

No network configuration is required to add or remove clocks from the network. To add a clock, simply install the batteries in analog clocks, or connect power to digital clocks. The slave clocks automatically connect to the multi-path network. An RC150 Mini-Master clock can be used while installing clocks to be sure the time signal is continuously available.

The analog clock movement turns on the internal radio transceiver for 5 seconds at 02:00 and 04:00 in preparation for a time update. Marathon digital clocks turn on their receiver at 01:00, 02:00 and 03:00. After which, it places the radio transceiver in sleep mode. In this mode, the transceiver is no longer operational and uses very little power to remain in sleep mode. If the batteries are removed while the transceiver is in sleep mode and immediately inserted, the hands will move to 12:00, but the movement will not receive a time update. This is because the capacitors within the movement keep the transceiver powered enough to remain in sleep mode for several minutes after the batteries have been removed. To reset the transceiver, remove the batteries for at least five minutes. Then insert the batteries. The hands will move to 12:00 and wait for reception. Then the hands will move to the correct time. If the radio transceiver is not reset, it will still receive a time update and move the hands to the correct time; however, it will

be some time later. If a battery clock is in low power mode, removing and reinserting the batteries, pressing the receive button, or shorting the reset pins will not enable for reception. A mini-master will not help. In this case the clock must be moved to a location in direct range of the master clock. It may require up to a day to sync with the master. Once the clock is running and displaying the correct time, it can be moved back to the original location.

**Changing batteries in battery powered analog clocks**

Batteries should be changed as soon as the clock second hand begins double stepping. If all clocks are double stepping, then first check that the transmitter is operational. When changing the batteries, bring the clock within direct range of the master clock or a calibrated mini-master in transmit mode must be present. **Remove all batteries, then insert new batteries. All replacement batteries must be new and of the same type.** After replacing the batteries, wait one day for it to sync with the master and then return it to the original location.

If the clock is displaying the correct time after changing the batteries, but is double stepping the second hand, go ahead and hang it back on the wall. Normal operation of the second hand should start by the next day.

Pressing the REC button or shorting the reset pins on the back of the clock movement may not cause the clock to receive a time update. Only removing all batteries and reinserting them will completely reset the movement.

When the master clock receives a time update from a network or GPS time server, a time source indicator (H, E or G) will appear in the right side of the LED display. E indicates the last time update received was from a computer network time server. G indicates the last update received was from a wireless GPS receiver. Multiple time sources may be used simultaneously. H indicates the clock includes an ultra-high precision oscillator.

Digital clocks typically illuminate the decimal point to indicate they are in sync. Analog clocks will step the second hand every two seconds if sync is lost for more than a day.

On 2.4 GHz devices, channels 0-15 correspond to 802.15.4 channel 11-26.

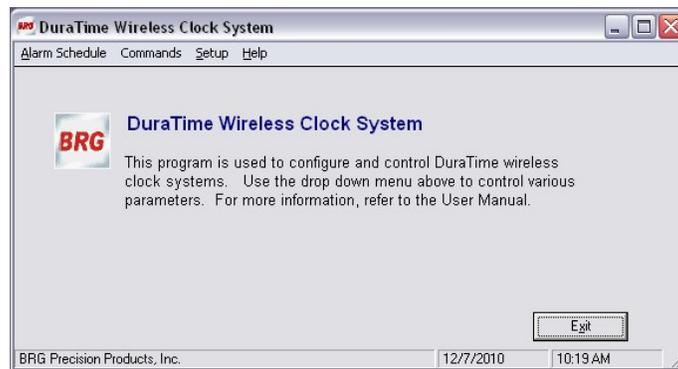
**Analog Clock Power Saving Feature**

The second hand motor uses 10 times the power of the hour/minute motor. Therefore, late model RC60 movements include a feature to disable the second hand motor at times when no one is around, such as at night and on weekends. Enabling this feature can extend the battery life many years. Modes 37-77, 37-78 and 37-79 are used to configure this feature.

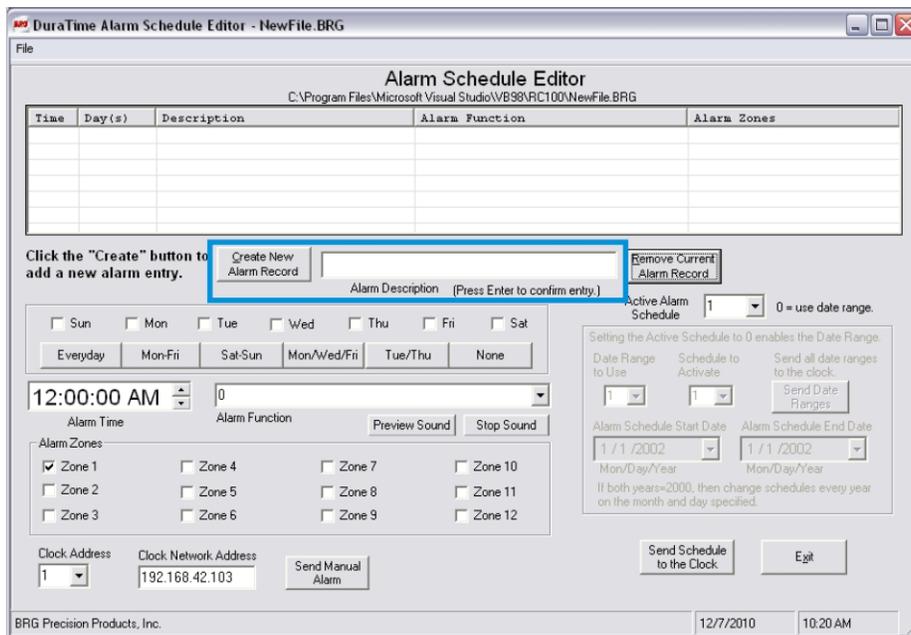
## Alarm Configuration

Each master clock has 999 total alarm settings that can be configured to activate a wireless audio alert / relay device at various times and days. For example a start lunch break alert horn could sound a constant tone for three seconds beginning at 12:00 noon, Monday through Friday. The end of lunch tone could be pulsed twice per second, for three seconds of duration. Wireless alarms will only be sent if the “T” is visible on the RC100 display. The relay output of the RC100 always operates. For greater reliability, the relay outputs of dual master clocks may be wired in parallel, with the same alarm schedule loaded in both master clocks, forming a redundant alarm system.

**The PC Control program for Windows is available for configuring the alarm functions.**

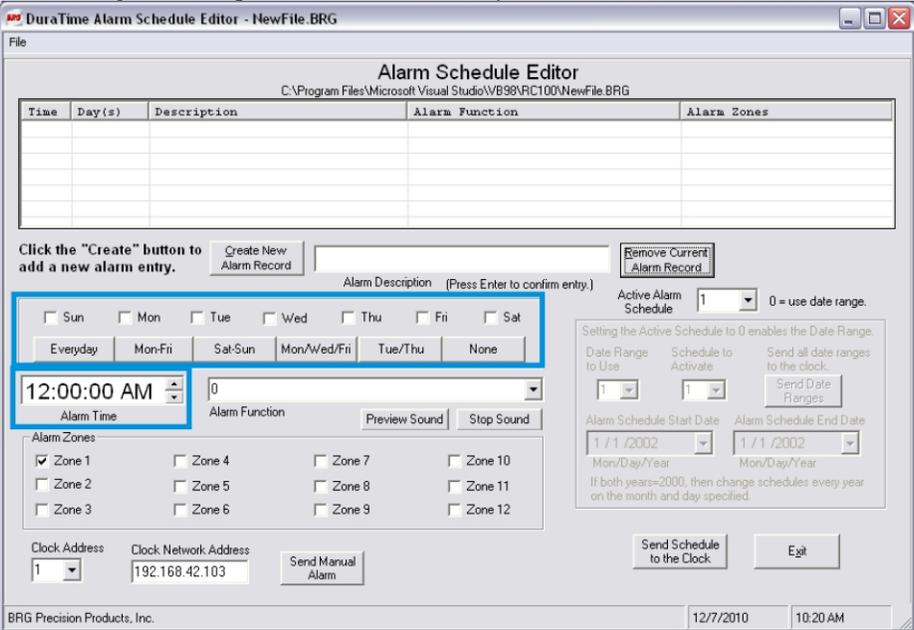


To enter the Alarm Schedule editor, click on Alarm Schedule menu above.

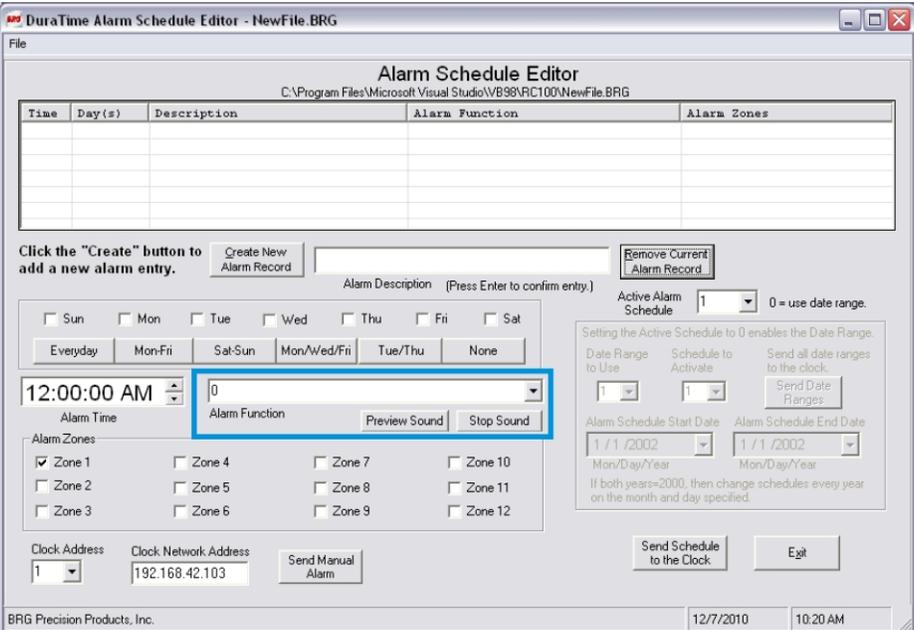


Click on the Create New Alarm Record button to add a new record to the alarm schedule.

Enter the description of the alarm item into the box next to the Create New Alarm Record button. Be sure to press the Enter key after entering the description to confirm the entry.

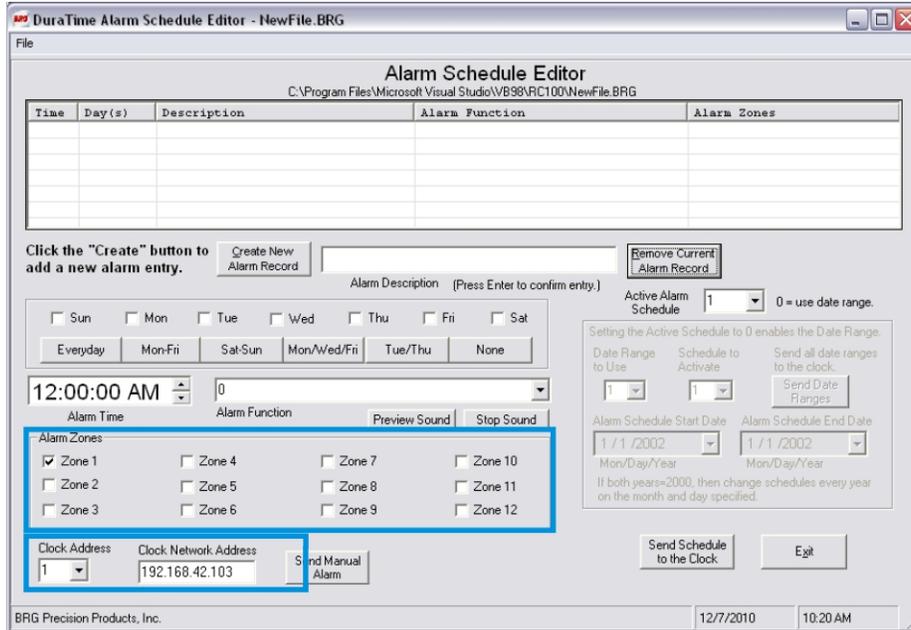


Next, select the day-of-the-week for the alarm to activate. Then select the time of day. Be sure to select AM or PM.

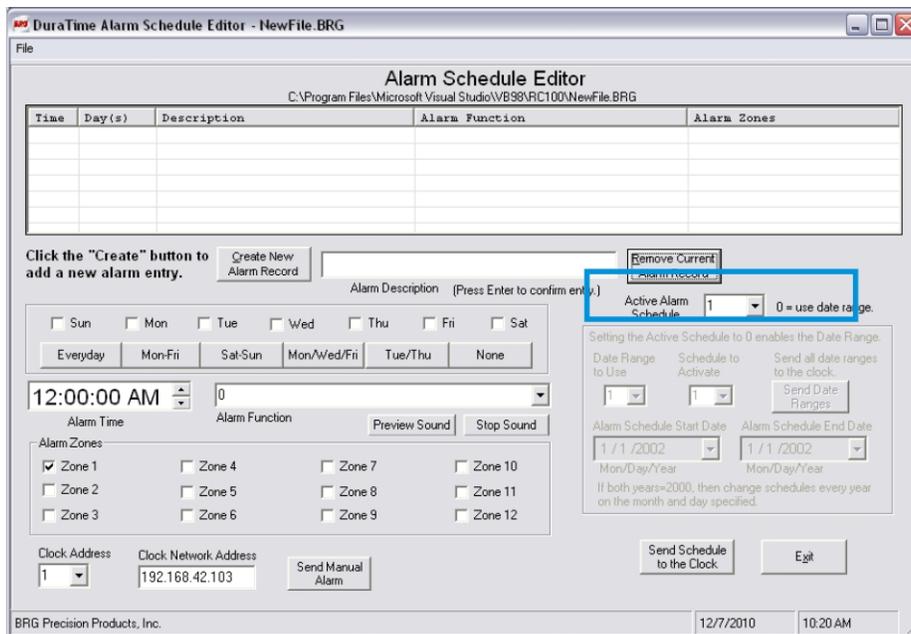


Now click on the Alarm Function drop down box to view the available alarm options. This drop down box is used to select either audio player recordings or relay contact closure using the wireless relay. The master clock also incorporates an alarm relay. The wireless relay must be configured to either play an audio recording with relay closure following the audio play, or a timed relay closure with the period determined by the drop down box selection in the alarm scheduler.

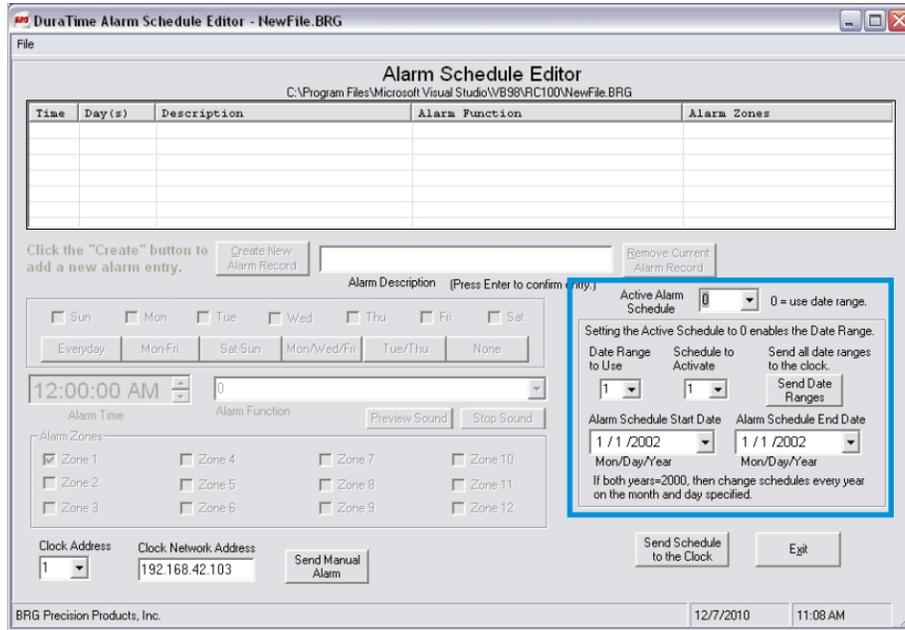
Note that there is a button to preview pre-recorded audio prior to scheduling them for play. A Stop Sound button is provided to interrupt lengthy audio selections.



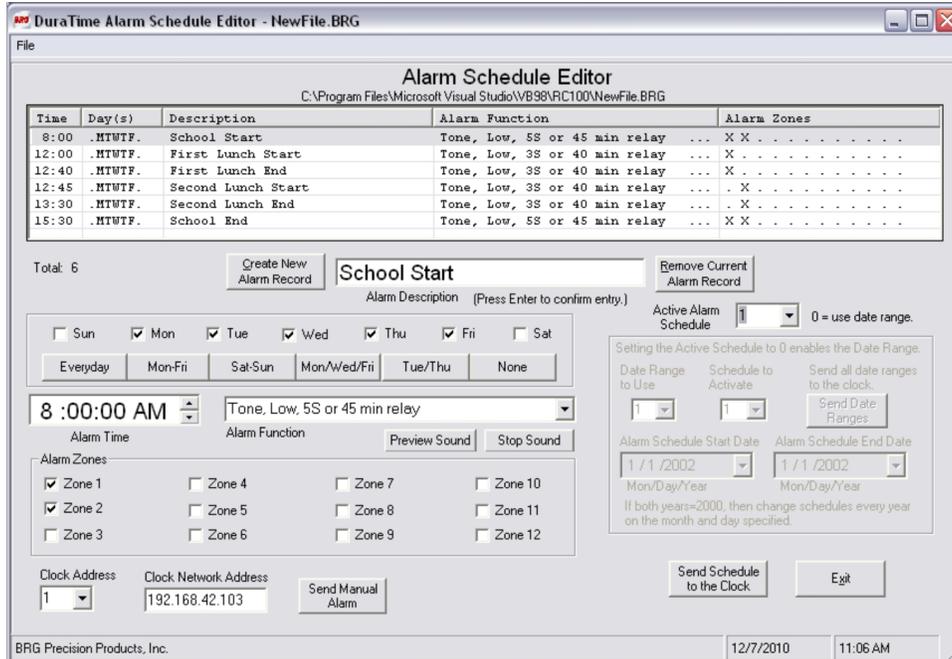
Each wireless alarm receiver may be configured to one of twelve zones, with zone 1 the default. The alarm schedule program may be used to select any combination of the twelve zones. For example, zone 1 could be used for one area of a building and zone 2 for another area. Each alarm entry could activate alarms in either zone or both zones simultaneously. The Clock address is used to select one of 99 master clocks. The default is 0 to select all master clocks. The IP address of the master clock to control must be entered.



Each set of alarms can be assigned to a group before sending to the master clock. Multiple alarm groups can be stored in the master clock and activated either manually or automatically by date range. For example, group 1 could be configured for every day except holidays, while group 2 could be configured for the holiday schedule.



When the Active Alarm Schedule number is set to 0, a date range may be used to automatically switch from one alarm schedule to another. Select a date range to use (1-20) and the alarm schedule number to activate. Then enter the desired date range. Once these items are selected, click on the Send Date Ranges button to send the activation schedule to the master clock. Change the Active Alarm Schedule number back to a number other than 0 to return to the alarm scheduler.



The above screen shot is an example of a simple alarm schedule that includes two zones. The Send Manual Alarm button at the bottom of the screen allows alarms to be sent immediately without being scheduled. To send a manual alarm, either select one of the existing scheduled alarms, or select the alarm type and zone, then click on the Send Manual Alarm button.

## Alarm Configuration Worksheet

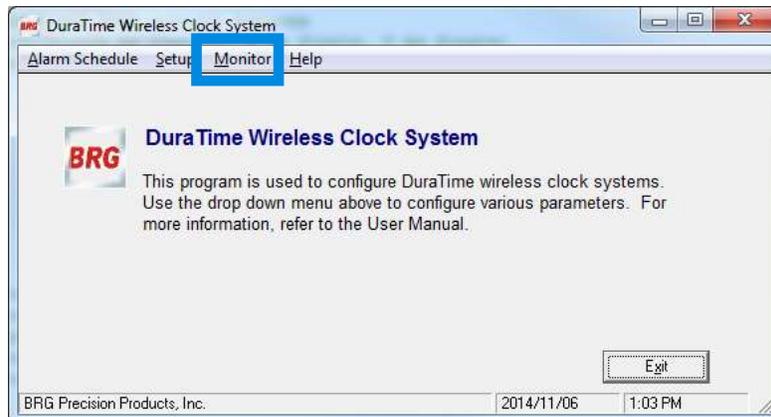
Alarm Position 1-99	Alarm Hours and Minutes	Alarm Seconds	Alarm Day Code	Alarm Zone Number	Alarm Sound Type or Relay Duration	Alarm Schedule Number
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
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## Clock Supervision Monitor

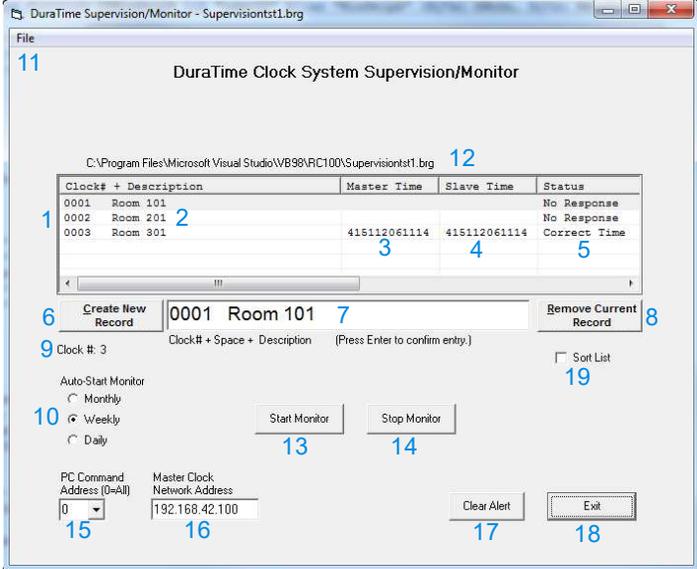
The Clock Supervision/Monitor feature is used to interrogate clocks to determine if they are receiving and storing time updates. Only LED digital clocks are supported at this time. It does not report malfunctions with the visual display. The monitor program will test the communications link between the control PC, and between the master and between the Master clock and the slave clocks. The monitor program will also test the time received and stored in the slave clocks and compare it with the master clock time.

Each slave clock must first be assigned an address. There are menu modes available in the slave clock for this function. In mega processor clocks, use Mode 86 to assign a unique address from 1 to 9999. In Tiger processor clocks, use mode 45-40 to assign the address. The address is used by the monitor program to identify the location of each clock.

To start the Monitor program, click on Monitor in the main control program.

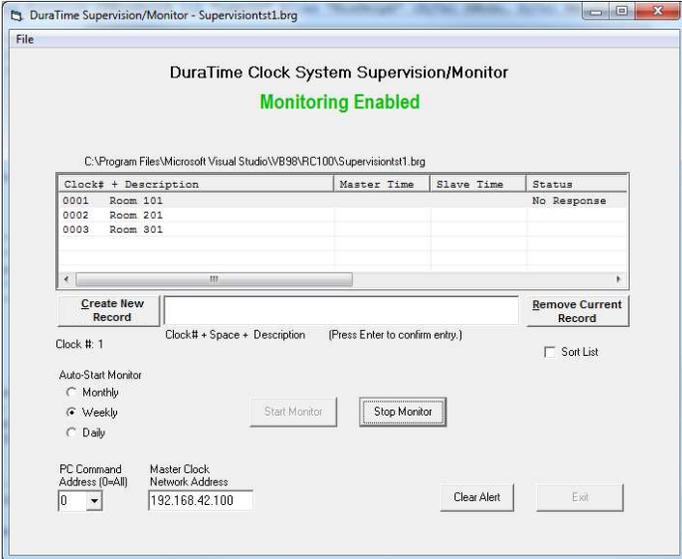


The Supervision/Monitor screen includes a variety of features as described below.

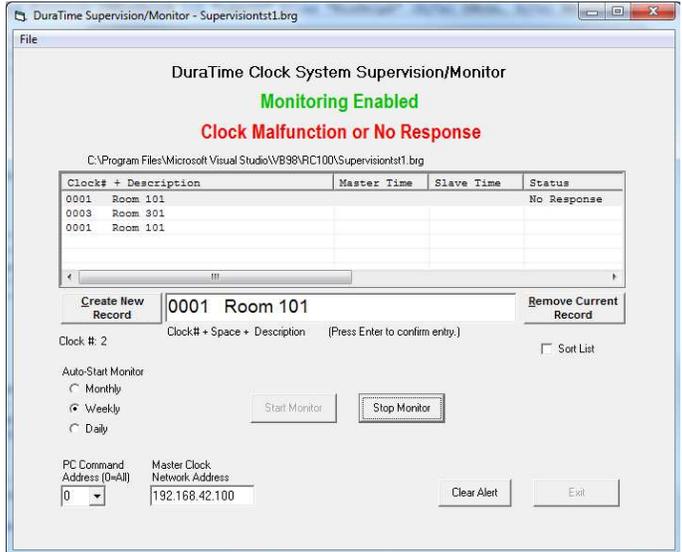


1. The database window lists the clock address, location description, master clock time/date, slave clock time/date and supervision status.
2. The location description should indicate the location of the clock
3. The Master Time indicates the time/date of the master clock at the time the slave clock was tested.
4. The Slave Time indicates the time/date stored and maintained by the slave clock.
5. The Status indicates No Response, Incorrect Time or Correct Time. No response results from either a communications failure or a malfunctioning clock.
6. To create a new slave clock record in the database, click on this button.
7. To enter a new clock record, first enter the clock address number. Leading zeros are not required. Next enter one or more spaces between the address and the description. Then enter the location description. You must then press the keyboard Enter key to confirm and store the entry.
8. To remove a record, left click on the record in the list. Next, left click on the Remove record button.
9. The current active record number.
10. The monitor can be configured to periodically monitor digital slave clocks.
11. The database file may be saved to a backup and restored at a later date. A new database file may also be created.
12. The active file name and path is displayed above the list box.
13. To manually start the monitor, click on the Start Monitor button.
14. To stop monitoring, click on the Stop Monitor button.
15. If multiple master clocks are used, they should be configured with a unique address. This list box is used to select the master clock that will be used to monitor the slave clocks. An address of zero selects any and all master clocks.
16. The IP address of the master clock must be entered here. The Ethernet interface in the master clock must be configured with the PC's IP address if the PC and Master clocks are on different subnets.
17. Clicking on this button clears the red alert message.
18. Click the Exit button to exit the supervision/monitor program.

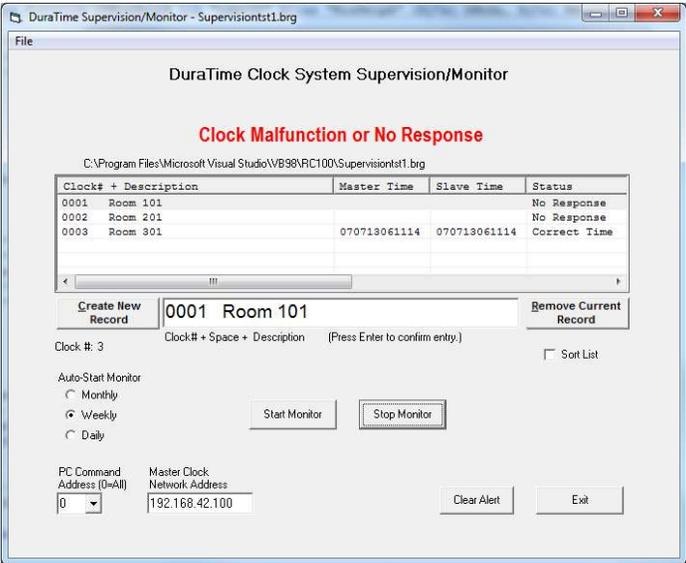
Clicking on the Start Monitor button starts the monitoring process. The green Monitoring Enabled message will be displayed on the screen.



During monitor, if a clock does not respond, or the master clock does not respond, or a clock responds with the incorrect time, an message will be displayed indicating a problem. The clock Status will indicate the specific problem. Clicking the Clear Alert button will clear the message from the screen. The following screen shows the alert message and the reason listed in the first clock status field as No Response.



The next screen shows two messages that will generate an alert message, even though the third clock is correct. An alert message will also be displayed if the slave clock time is not close to the master clock time.



The monitor program must remain running while the slave clocks are monitored. The monitor program must also remain running if Auto Start Monitor is selected.

## Master Clock Configuration Menu

### General Menu Navigation:

Clock/Timer/Counter configuration is accomplished by editing parameters using a simple menu system. Only four buttons are used to navigate the menu. The Mode button enters the Menu. The Up and Down buttons move up and down through the menu items, and are used to change parameter values. The Timer Control (TC) button is used to save any changes and exit the menu system.

Operation – Press and hold the Mode button to access the menu system. The hours and minutes will blink for several seconds. When the hours and minutes stop blinking, release the Mode button. 1 will appear on the display. This is menu position 1. Using the Up and Down buttons, select the desired menu item. Press the Mode button again to display the parameter. For menu items 20 and above, press Mode again to access the menu's second level. When a 1 appears, indicating the second level menu, press the Up or Down buttons to select the desired menu item, then press Mode to display the parameter value. Press the Up or Down buttons to change the parameter value. Once the parameter value is changed, press Mode to back out of the item and move to another item, or press the Timer Control (TC) button to save and exit the menu system. Pressing the Timer Control button at any time will save your changes and exit the menu system.

Pressing the Mode button while a parameter value is displayed will back up one level. Press Up or Down to move to the next mode item. Pressing the Down button until mode 0 is reached will exit the menu system. Pressing the Timer Control (TC) button also exits the menu system. The menu will timeout and return to normal operation after 60 seconds in inactivity.

A special operation menu is available for restoration and diagnostic purposes. Pressing and holding the Mode button will cause either four ones or four twos to be displayed. Four ones means no configuration has been stored in secondary memory. Four twos means a previous configuration has been stored in secondary memory.

Continuing to hold down the Mode button allows shortcut menu operations. The ones or twos will disappear and the display will begin counting up from 0. Special commands will execute if you release the Mode button while one of the numbers are displayed. The special commands are:

0= Set analog clock power save mode on. A "--" (dash) will appear on the upper right corner of the display when power save mode is enabled.

1=Software reset

2=Restore factory defaults, once the 2 appears, release the mode button and momentarily press the Timer Control (TC) button

3=Restore customer defaults from secondary memory (if previously stored), once the 3 appears, release the mode button and momentarily press the Timer Control (TC) button. This command does not restore the radio configuration (Mode 75-4 and Mode 75-5)

4=Store customer defaults in secondary memory, once the 4 appears, release the mode button and momentarily press the Timer Control (TC) button. This command does not restore the radio configuration (Mode 75-4 and Mode 75-5)

6= Sends a test alarm command to wireless audio players to play audio file 1 on zone 1.

**Pressing the Mode and Up buttons at the same time will restore user defaults. If user defaults are unavailable, factory defaults will be restored.**

First Menu Level Mode Number	Second Menu Level	Value Range	Mode Description and Instructions
0	N/A	00:00 to 23:59	<b><u>Exit Menu System</u></b> Simply press the Up button to advance the time, or the Down button to decrement the time. The longer the buttons are held down, the faster the time will change. Pressing the Timer Control button will also exit the menu system.
1	N/A	01/01 to 12/31	<b><u>Month/Day</u></b> Pressing the Up button increments the days and months, pressing the Down button decrements the days and months. Incrementing past the end of the year, or decrementing past the beginning of the year, will change the year respectively
2	N/A	1992-2075	<b><u>Year</u></b> Change using the Up and Down buttons
3	N/A	1-15	<b><u>Display Intensity</u></b> 1=lowest intensity, 99=highest intensity.
13	N.A	0,1	<b><u>Active Alarm Schedule and Zone Checkbox</u></b> 0=(default) The assigned schedule number is compared with the active schedule 1= Control Program zone checkbox must match Active Schedule Number  When Mode13=0, if the assigned schedule (Mode 30) is equal to the active schedule, then the alarm time parameters are evaluated.  When Mode 13 = 1, the Zone that matches the active alarm schedule must be checked to allow the alarm to activate.
19	N/A	0 00 to 9 99	<b><u>Software Version Number</u></b> Displays the clock software version number. Press the Mode button to exit or let the menu timeout.
21	1	-12 to 12 hours from UTC	<b><u>Time Zone Offset</u></b> This value determines the number of hours to add or subtract from Universal Coordinated Time. This parameter is usually only used with time zone clocks or clocks containing an atomic clock receiver. See also Mode 33 for forced half hour and one hour offsets. <u>For accurate time zone information, see <a href="http://www.timeanddate.com">http://www.timeanddate.com</a></u>
23	1	12, 24	<b><u>12 or 24 hour display format</u></b> default=12  This mode selects either 12 or 24 hour display format for each four digit display when

First Menu Level Mode Number	Second Menu Level	Value Range	Mode Description and Instructions
24	1	0,10	<p>displaying real time.</p> <p><b><u>Daylight Saving Time</u></b>            This mode selects the rules to use when automatically switching between Daylight and Standard time.            0=disable daylight time;            10=rule based switching (default)            See also Mode 52 and Mode 45-20, Mode 45-21</p>
27	1-99 alarm setting	00:00 to 23:59	<p><b><u>Alarm Set Time Hours / Minutes</u></b>            This mode is used to set the alarm hour and minutes. There are 99 possible settings. Mode 28 optionally sets the seconds. Mode 29 determines the day(s) to activate the alarm(s). <u>A day code must be set to enable alarm.</u> Mode 32-23 enables (default) or disables the alarms. Mode 38 contains alarm schedule assignments. Mode 37-1 determines which schedule is active. Mode 32-16 activates alarms in slave clocks. Mode 49 enables alarm toggle on/off. This overrides momentary alarm activation. Mode 37-2=1 enables snooze function to turn off alarm before the predefined alarm duration has expired. See Mode 34 to activate the alarm at sunrise and/or sunset. See Mode 49 to use the real time alarm settings to control timer functions. See also Modes 28, 29, and 59.</p> <p>In Tiger version 3.75 and later, the number of alarm entries has expanded from 100 to 1000. The 1000 alarm entries are stored in 10 different schedules of 100 entries each. When Mode 37-1=0, alarm schedules will automatically change depending on the active date range. There are 20 date ranges available. The Mode 38 function has changed. It now determines which schedule is active for date ranges defined in Modes 53, 54, 55 and 56. Setting Mode 32-4=4 allows the Timer control button to switch between schedules 0-10 (0 activates date range switching). Press Timer Control to access Mode 37-1. Use the Up and Down buttons to change the schedule from 0-10, then press Timer Control to save and exit.</p>
28	1-99 alarm setting	00 to 59	<p><b><u>Alarm Set Time Seconds</u></b>            This mode is used to set the alarm seconds. There are 99 possible settings. Mode 29 determines the day(s) to activate the alarm(s). <u>A day code must be set to enable alarm.</u></p>
29	1-99 alarm setting	0-15 day code	<p><b><u>Alarm Day Code</u></b>            This mode is used to set the alarm day code.            The possible values for each alarm setting are:            0=no alarm,            1=Monday,            2=Tuesday,            3=Wednesday,            4=Thursday,</p>

First Menu Level Mode Number	Second Menu Level	Value Range	Mode Description and Instructions
			5=Friday, 6=Saturday, 7=Sunday, 8=Everyday, 9=Weekdays, 10=Sat/Sun, 11=Mon/Wed/Fri, 12=Tue/Thu, 13=Tue-Sat., 14=Mon-Thu, 15=Mon-Sat  Display and time source number 1 is used for alarm activation in multi-display clocks.  In addition to day-of-the-week combination codes, Mode 29 also accepts any day combination. A value greater than 128 is treated as a binary command. Days of the week are assigned the following binary numbers: Mon=1, Tue=2, Wed=4, Thu=8, Fri=16, Sat=32 and Sun=64. Any combination of days may be selected by adding their assigned numbers together and then adding 128 to that value. For example, if Mon, Wed and Fri are required, then the value would be 149 (1+4+16+128=149).
30	1-99	1-99	<p><b><u>Alarm Schedule Assignment</u></b>            1=default            Each alarm entry is assigned a schedule number. If the assigned number equals the active schedule number in Mode 37-1, then the alarm time and day-of-the-week parameters are evaluated. By default, every alarm entry is assigned schedule 1. The control program can also be used to change this parameter.</p>
32	5	0-11	<p><b><u>Alarm Zone Address</u></b>            0-11 , 0=default             This value determines the alarm zone of this clock's relays.</p>
32	14	0-99	<p><b><u>Auto Brightness Option</u></b>            0 = disable optional auto brightness control,             1-99 optional auto brightness offset to all display intensity. This option is typically used in areas where lighting conditions change such as video conferencing rooms and communications centers.             See also Modes 3, 37-83 and 51-7.</p>
32	16	0-1	<p><b><u>Alarm master/slave control</u></b>            0=disable (default),             1=enable remote alarms             Secondary clocks may follow the alarm sounding of a master clock. This allows one clock to control the alarm sounding of several alert horns. For example, one master clock could contain the alert horn schedule for the entire building. Several secondary clocks with the alert horn option could be controlled by the alarm schedule of the master clock. Both Master and secondary clocks must have Mode 32-16 enabled for</p>

First Menu Level Mode Number	Second Menu Level	Value Range	Mode Description and Instructions
32	23	0,1	<p>this method to operate.</p> <p><b><u>Scheduled Alarm Time Activation</u></b>            0=deactivate scheduled alarms,            1=activate scheduled alarms (default).</p>
32	42	0-99	<p><b><u>Clock Address for PC Control</u></b>            (default=0) If the address value sent equals the value specified in this mode, then the clock will accept the data packet. For PC control, all clocks may be addressed by sending address 0.</p>
32	59	0,1	<p><b><u>Accept or Ignore Global PC Commands –</u></b>            1=accept (default)            0=reject global address PC commands            PC commands received with an address of 0 will be ignored if Mode 32-59=0.</p>
32	63	0,1	<p><b><u>Transmit Indicator</u></b>            0= (default) The letter T alternates with the transmitter mode indicator            1= A period is displayed on the left side of the display</p> <p>The “T” transmitter indicator displays with each packet transmission. The clock does not transmit until there is a sync indicator displayed (H, E, OR G). The period transmit indicator on the left of the display blinks until a sync indicator is displayed. Once the sync indicator is displayed and the clock is configured to transmit, the transmit period indicator will turn on solid.</p>
32	68	0-5	<p><b><u>Time Reception Port Control</u></b>            0=receive time on both ports if configured; otherwise, does not receive remote GPS time packet either over the air or from Ethernet.</p> <p>2= receive time on GPS port only, does not receive remote GPS time packet either over the air or from Ethernet.</p> <p>3= do not receive time on any port, does not receive remote GPS time packet either over the air or from Ethernet.</p> <p>4= receive time on GPS port from a remote GPS receiver over the air.</p> <p>5= receive time on SRST port from a remote GPS receiver using the Ethernet cable (SRST port). NTP time and other standard time packets will be ignored.</p> <p>6= (default) receive standard time packets (NTP) over the Ethernet port and time packets over the air from a remote GPS receiver. This configuration provides a redundant time source. If one of the time sources provides incorrect time, the master and slave clocks may jump periodically between the two times.</p> <p>This configuration does not affect the reception of commands, only the reception of time broadcasts.</p>
32	69	0-99	<p><b><u>Master Clock Time Transmission Control</u></b></p>

First Menu Level Mode Number	Second Menu Level	Value Range	Mode Description and Instructions
			<p>0 = (default) Single master clock operation - send time packets even if other master clocks are also sending time packets. The master clock will continue transmitting even if the sync source is lost.</p> <p>1 = Primary master clock operation only when sync active - When two master clocks are used, set Mode 32-69=1 on one of the master clocks, and set Mode 32-69=2 on the other master clock. If High Precision (H), GPS (G) or NTP (E) sync is lost on the primary master, it will cease time transmissions. The secondary master will then take over and resume time transmissions. When the primary master receives a time update, or the high precision oscillator is active, it will resume time transmissions and the secondary master will cease transmissions.</p> <p>2 = Single or Secondary master clock operation – if time transmissions from other master clocks are detected, the secondary master clock will not transmit time packets until other time transmissions cease. In this configuration, the secondary master clock automatically backups the primary master clock. The loss of time source sync will not disable time transmissions.</p> <p>Both primary and secondary master clocks will receive GPS and/or NTP time updates whether they are transmitting time packets or not.</p> <p>In dual-redundant master clock configurations, a “P” on the upper left of the display indicates that it’s configured as a primary master clock. An “S” indicates it’s configured as a secondary master clock.</p> <p>In a single master clock configuration, the “S” indicates single mode operation. In this mode, the clock will transmit whether or not it is receiving time updates.</p> <p>See also Mode 32-72</p>
32	71		<b><u>Reserved</u></b>
32	72	0-99	<p><b><u>Time Transmission Delay Duration</u></b>            0=99            1=default            Delay in minutes to stop time transmissions.</p> <p>See also Mode 32-69</p>
32	73	0-3	<p><b><u>Time Transmission Period Control</u></b>            0= transmit time once per second            1= transmit when second unit equals 1, 4 or 7            2= transmit on the even second (default)            3= transmit on the odd second</p> <p>This mode configures the time packet transmission rate as indicated above.</p>
32	81	0-3	<p><b><u>Ultra-High Precision Oscillator Support</u></b></p> <p><b>Oven Controlled (OCXO) and Rubidium (RbO) Oscillator Configuration</b></p> <p>0 (default) disable ultra-precision support,            1=calibrate the TCXO using the OCXO or RbO once per minute,</p>

First Menu Level Mode Number	Second Menu Level	Value Range	Mode Description and Instructions
32	84	0-199	<p>2=calibrate the TCXO using the OCXO or RbO once per hour, 3=calibrate the TCXO using the OCXO or RbO once per day</p> <p style="padding-left: 40px;">Port 65 - OCX Reset Output Port 66 - OCX 1 BPS input</p> <p><b><u>Automatic Leap Second Adjustment</u></b> 0=disabled (default)</p> <p>The mode is used when a leap second will occur sometime in the future and external synchronization is not used. It is normally used with ultra-high precision oscillators such as oven controlled or Rubidium oscillators.</p> <p>A value of greater than 0 and less than 100 will add a leap second on June 30 at 23:59:59 UTC of the designated year.</p> <p>A value greater than 100 will add a leap second on December 31 at 23:59:59 UTC of the designated year (100+Year).</p> <p>A value of 99 will add a leap second on the current day at 23:59:59.</p> <p>During the change, at midnight, 0:00:00 displays for two seconds. When the leap second is added, Modes 32-84 will be reset to 0.</p>
33	1	0-5 code	<p><b><u>Force Time Advance</u></b> This mode optionally forces a 30 to 60 minute time advance.</p> <p>0= no advance (default), 1=30 minute advance, 2=60 minute advance, 3=30 minute advance during daylight saving time only, 4=60 minute advance during daylight saving time only, 5=45 minute advance.</p> <p>This is used in areas that have a 30 to 60 minute advance over the area time zone. For example, Mumbai, India's time zone offset is +5:30. To configure the time zone, first set the zone to +5 hours using Mode 21-1. Then set Mode 33-1 to 1.</p>
37	1	1-99	<p><b><u>Active Alarm Schedule</u></b> (default=1) This parameter determines which (1-98) alarm schedules is active. Setting Mode 37-1=0 will cause the date ranges to be used. Use Mode 53,54,55 and 56 to change date ranges. Alarm group 1 is different than the other 19 alarm groups. If no date range is active, then group is 1 the default. This feature reduces the number of alarm entries required in some schedule situations. See also Mode 38 – Alarm Schedule Group Assignment. A value of 99 in mode 38 will cause the alarm to activate in all schedules if the day code matches the current day.</p> <p>The 1000 alarm entries are stored in 10 different schedules of 100 entries each. When Mode 37-1=0, alarm schedules will automatically change depending on the active</p>

First Menu Level Mode Number	Second Menu Level	Value Range	Mode Description and Instructions
37	2	0-2	<p>date range. There are 20 date ranges available. The Mode 38 function has changed. It now determines which schedule is active for date ranges defined in Modes 53, 54, 55 and 56. Setting Mode 32-4=4 allows the Timer control button to switch between schedules 0-10 (0 activates date range switching). Press Timer Control to access Mode 37-1. Use the Up and Down buttons to change the schedule from 0-10, then press Timer Control to save and exit.</p> <p><b><u>Manual Alarm Button</u></b>            This Mode applies to the master clock relay only. When this Mode is enabled, alarm schedule switching using the Timer Control (TC) button is disabled.</p> <p>0=not active (default),</p> <p>1=code blue line toggles alert horn on and off. Mode 45-19 optionally determines the number of seconds the alarm will sound before automatically turning off. If the timeout value is 0, the alarm will sound until the code blue line is momentarily closed.</p> <p>This setting will also cause the timer control button to act as a snooze button, turning off the alarm before the alarm period has expired.</p> <p>2=alert horn will sound as long as code blue line is closed. The Panic Alarm function overrides all other timer control functions. This mode may used with real time alarms to turn off the alarm before the predefined alarm duration expires.</p>
37	3	0,9	<p><b><u>58<sup>th</sup>/59<sup>th</sup> Minute Transmit</u></b>            0=disabled (default)            9=enabled</p> <p>When 58<sup>th</sup>/59<sup>th</sup> minute sync transmit is enabled, the internal relay will be used to send sync pulses to secondary clocks. When enabled, the internal relay is no longer used as an alarm relay. Wireless alarm relays must be used. When 59<sup>th</sup>/59<sup>th</sup> minute sync is disabled, the internal relay can be used for alarms.</p>
37	10	0-18	<p><b><u>Analog Clock Time Zone Position Number</u></b>            0 = disabled            1-18 = enabled</p> <p>This mode is used to configure the zone position number of analog clocks used in a time zone display. This number is the sequence of available clock zones. It is not the offset from UTC. More than one clock may use the same zone number if the offset from UTC are to be the same. Set Mode 37-10 to the desired zone number 1-18. The master clock will then begin broadcasting on this zone, plus flag instructing the analog clock to save the zone number. Once the master clock is broadcasting the time zone command, remove and reinsert the analog clock's batteries. The hands will begin to move. Once they stop, set mode 27-10 back to 0. To configure another clock, repeat the process.</p> <p>The zone position number will appear in the upper right corner of the master clock while the time zone position command is active.</p> <p>This feature is available in RC100TZ version 4.87 and later.</p>
37	28	0,1	<p><b><u>Enable/Disable Analog Time Zone Master Clock</u></b></p>

First Menu Level Mode Number	Second Menu Level	Value Range	Mode Description and Instructions
37	29	0-99	<p>0=Disabled (default) 1=Enabled</p> <p>The mode reconfigures the RC100 as a Time Zone Master clock for analog wall clocks.</p> <p><b><u>Control Button Lockout and Addressable Clock Function</u></b> 0=Disabled (default)</p> <p><u>To lockout all buttons, set</u> 32-4=0 32-55=1 37-29=2 Press Up and Down at the same time to access the menu system.</p> <p>1=Disable the Mode button x minutes after the last button press. Up and Down button work normally. See also Mode 32-55.</p> <p>2=Disable the Mode, Up and Down buttons x minutes after the last button press. Mode 32-49 determines the delay period. To enable the buttons, press and hold the Mode button until four one's or four two's appear (about 5 seconds), then release the mode button. Pressing the Up and Down buttons simultaneously will also enable the buttons.</p> <p>3=Disable the Mode, Up and Down buttons x minutes after the last button press. Mode 32-49 determines the delay period. Pressing the Up and Down buttons together will <u>not</u> enable the buttons. To enable the buttons, press and hold the Mode button until four one's or four two's appear (about 5 seconds), then release the mode button.</p> <p>4=Addressable Clock Function with Inactive Up and Down buttons – This mode disables access to the clock until the clock's address is displayed. To display the clock's address, hold the mode button down until the display stops flickering and a number appears. This is the clock's address. If the mode button is released while the clocks address is displayed, then access to the menu system will be granted.</p> <p>Once the buttons are enabled, a one will appear and the clock will display the first menu address position. Press down to return to the normal display or use the Up button to move to the desired menu item.</p> <p>After exiting the menu system, the access will be denied after a delayed period determined by Mode 32-49. Mode 32-42 is used to set the clock's address. See also Mode 32-55.</p> <p>5=Addressable Clock Function with Active Up and Down buttons when the clock as actively selected – This mode is the same as Mode 37-29=4, except the Up and Down buttons remain active. For example, a display could have three displays. Two of the displays could show real time, while the third displays may be a timer that requires active Up and Down buttons. The remote could be used to access any of the displays. In this scenario, if one of the real time displays is accessed, you may see activity on the timer because the Up and Down buttons would be active on both the real time display and the timer. See also, Mode 32-55, Mode 32-42 and Mode 32-49.</p> <p>6=Addressable Clock Function with Active Up and Down buttons whether or not the clock as actively selected – This mode is the same as Mode 37-29=5, except the Up and Down buttons remain active all the time, whether the clock is actively selected or not. For example, a display could have three displays. Two of the displays could</p>

First Menu Level Mode Number	Second Menu Level	Value Range	Mode Description and Instructions
37	33	0-99	<p>show real time, while the third displays may be a timer with external control that requires active Up and Down buttons. The remote could be used to access any of the displays. In this scenario, if one of the real time displays is accessed, you may see activity on the timer because the Up and Down buttons would be active on both the real time display and the timer.</p> <p>See also, Mode 32-55, Mode 32-42 and Mode 32-49.</p> <p><b><u>Radio Power On Period</u></b>            0=5 sec (default)            1-99 = seconds to power the radio</p> <p>This mode determines how long the battery powered radio in analog clocks will remain on before going to sleep mode. By default, the mode is set to zero which flags the radio to remain powered for 5 seconds. This allows enough time to obtain a time update and repeat five time update packets, while maximizing battery life. However, it is too little time to gain control over the air to reprogram the device. If the radio needs to be reprogrammed over the air, set Mode 37-33=30. This will keep the radio powered for 30 seconds which should be enough time to reprogram the radio. Once programming is complete, return Mode 37=33 to 0 to maximize battery life in the analog clocks. This mode requires RC100 Tiger version 1.20 or later and analog clock radio firmware version 1.8 or later.</p>
37	63	0,1	<p><b><u>Message Board Time Updates</u></b>            0=disabled (default)            1=enabled</p> <p>This mode enables time update transmissions to message boards. Updates are sent hourly at 2 minutes and 10 seconds after the hour.</p>
37	65	0-99	<p><b><u>Wireless/Ethernet Sync Indicator Delay</u></b>            5= (default)</p> <p>This value determines the number of minutes between a change in sync status and resetting the sync status indicator.</p>
37	76	0-3	<p><b><u>Wireless Analog Clock Movement Support</u></b></p> <p>0 =activate full time reception only on the days of DST (default),            This setting is for Chouchin or Shengbang movements with the hands installed at the 10:00 position, and Mode 37-62=9. If Mode 37-62=9 then on the day to switch from ST to DST or DST to ST, and the previous day, no transmissions will occur if the hour is less than 2 or greater than 19.</p> <p>1= activate full time reception once per month on the 1st,            If Mode 37-62=7 or 9 then on the first day of the month, no transmissions will occur when the hour equals 0, 22, or 23.</p> <p>2= activate full time reception twice a month on the 1st and 15th,            If Mode 37-62=7 or 9 then on the first and fifteenth day of the month, no transmissions will occur when the hour equals 0, 22, or 23.</p> <p>3= activate full time reception every day.            If Mode 37-62=7 or 9 then everyday, no transmissions will occur when the hour equals 0, 22, or 23.</p>

First Menu Level Mode Number	Second Menu Level	Value Range	Mode Description and Instructions
37	77	0-10	<p>4= activate full time reception every day. If Mode 37-62=7 or 9 then everyday, no transmissions will occur if the hour is less than 2 or greater than 19. This mode can be used for externally powered clocks and DuraTime battery powered analog clocks.</p> <p>This mode determines when movements are forced to use all time data received. All other regular reception times, the Chouchin just receives and corrects the seconds. Full time reception also occurs when the batteries are inserted, when the reset pins are shorted, or when the receive button is pressed for three seconds. During full time reception, the clock hands stop until all time is received. Then the hands move to the time received.</p> <p><b><u>RC60 Analog Clock Movement Second Motor Control</u></b> (not used with analog time zone displays)</p> <p>This mode conserves power in battery powered model RC60 analog clock movements by turning off the second hand motor at times when it is not needed. The second hand motor operation can be reduced up to 157 million motor pulses over a five year period. This not only conserves battery power, but also prolongs the life of the movement. Modes 37-78 and 37-79 determine the hour to turn the second motor on and off.</p> <p>0 - second motor always on 1 - turn off second motor Monday only 2 - turn off second motor Tuesday only 3 - turn off second motor Wednesday only 4 - turn off second motor Thursday only 5 - turn off second motor Friday only 6 - turn off second motor Saturday only 7 - turn off second motor Sunday only 8 - turn second motor off all day Sunday plus designated hours other days 9 - (default) turn second motor off all day Saturday and Sunday plus designated hours other days 10 - Everyday using designated hours 11- Turn second motor off 23 hours per day in first generation RC60 movements 12- Turn second motor off 24 hours per day in second generation RC60 movements (do not combine with first generation movements)</p>
37	78	0-23	<p><b><u>RC60 Analog Clock Movement Second Motor Hour to turn On</u></b> 6=turn on motor at 6:00 (default)</p> <p>This mode determines the hour to turn the analog clock movement second motor on.</p> <p>Setting Mode 37-77=12 or (Mode 37-78=23 and Mode 37-79=23) will turn second motor off 24 hours per day in second generation RC60 movements (do not combine with first generation movements).</p> <p>See also Modes 37-77 and 37-79</p> <p><b><u>Number of Analog Clock Time Zones in an Analog Time Zone Display</u></b></p>

First Menu Level Mode Number	Second Menu Level	Value Range	Mode Description and Instructions
37	79	9-23	<p>1-18 8=default</p> <p>This mode determines the number of time zones in an analog time zone display. Mode 18 should be set to the same value.</p> <p><b><u>RC60 Analog Clock Movement Second Motor Hour to turn Off</u></b> 20=turn off motor at 20:00 (default)</p> <p>This mode determines the hour to turn the analog clock movement second motor off.</p> <p>Setting Mode 37-77=12 or (Mode 37-78=23 and Mode 37-79=23) will turn second motor off 24 hours per day in second generation RC60 movements (do not combine with first generation movements).</p> <p>See also Modes 37-77 and 37-78</p>
37	80	0-3	<p><b><u>Analog Clock Power Saving Mode</u></b> Requires receiver version 2.6 or later and RC100 master clock version 1.27 or later.</p> <p>0=disabled (default)</p> <p>1= Sync at 2:00:40</p> <p>2= Sync at 2:00:40 and 4:00:40.</p> <p>To enable power saving mode with a value of 1, press and hold the Mode button. The display will blink for a few seconds. When a 0 will appears in the minutes position, release the Mode button. The control program may also be used to enable power saving mode.</p> <p>This mode reduces the number of times the radio activates in a day. The reduction in receiver run time translates to savings in battery power. This allows much longer periods between battery changes.</p> <p>When the batteries are initially installed, the movement will turn on as normal and receive the current time. It will continue to turn the receiver on at the normal cardinal points. However, at 04:00:40 (RC50 step movement) and 03:00:40 (RC60 sweep movement), the movement will switch to power saving mode. The receiver will not power up again until the same time the following day.</p> <p>While in power saving mode, pressing the receive button on the movement will pause the movement, but it will usually not receive a new time update. Shorting the movement reset pins or re-installing the batteries will reset the movement, but it will usually not receive a time update. The proceeding operations will force the radio to turn of if they are performed up to seven times, depending on the time of day.</p> <p>If Mode 37-80 is set to 1, a step (RC60) movement and sweep (RC61) movement will receive once a day at 02:00:40 and RC50 step movements will receive twice a day at 02:00:40 and 04:00:40. All analog movements, LCD, LED clocks may be used in the same system when Mode 37-80=1.</p> <p>If Mode 37-80 is set to 2, Chouchin (RC50) movements will receive once a day at 04:00:40. Do not mix RC50 and RC60 movements and LCD clocks on the same</p>

First Menu Level Mode Number	Second Menu Level	Value Range	Mode Description and Instructions
			<p>system when Mode 37- 80=2. This setting is only intended for Chouchin (RC50) movements.</p> <p>If Mode 37-80 is set to 0 to disable the power saving mode, the movement will return to normal operation the next time it receives a time update. This operation offers higher clock precision, but with an increase in battery usage.</p>
37	81	1-8	<p><b><u>Alarm Duplicate Packets</u></b> 1-8, 2=default Wireless alarms are now sent multiple times 300 ms apart. Mode 37-81 (default=3) determines the number of times to send the alarm command.</p>
37	82	0-1	<p><b><u>Repeat Radio Data Received out the Ethernet Port</u></b> 0=Disabled (default) 1=Enabled This mode causes 35 byte data packets received from the radio to be sent out the Ethernet port. The control program can be used to monitor radio traffic. A master clock cannot monitor its own transmissions, but a secondary master can monitor the primary master clock's transmissions.</p>
37	83	1-15	<p><b><u>Alpha 5x7 Matrix Intensity Control</u></b>  For older digital lettering using Toshiba drivers, Mode 51-7 controls individual display digits. However, for new displays using HT1632 drivers, Mode 51-7 controls all the digits on a single display board. The last digit of the display controls the intensity for that display. Adjusting Mode 51-7 for other positions has no effect. For example, a clock has one 5 digit display followed by one 10 digit display. To adjust the brightness of only the 10 digit display, change Mode 51-7-15. To adjust only the five digit display, change Mode 51-7-5. Mode 51-7 overrides Mode 3 (all intensity), Mode 37-83 (all alpha intensity) and auto-intensity.  See also Modes 3, 32-14 and 51-7.</p>
38	1-99	1-99	<p><b><u>Alarm Schedule Group Assignment</u></b> Assigns each alarm setting to an alarm schedule group. (default=1) See also Mode 37-1 – Active Alarm Schedule. Setting Mode 37-1=0 will cause the date ranges to be used to determine which alarm schedule is active. Date ranges for each alarm schedule are set in Modes 53, 54, 55, and 56. Alarm group 1 is different than the other 19 alarm groups. If no date range is active, then group is 1 the default. This feature reduces the number of alarm entries required in some schedule situations.</p>
45	19	0-9999	<p><b><u>Panic Alarm Timeout Value</u></b> 0=default - This value is used in conjunction with Mode 37-2 (Alarm Panic Button). When timeout seconds are greater than zero, the panic alarm will turnoff when the timeout time is reached.</p>
45	20	111 – 3231	<p><b><u>Daylight Saving Rule – Start DST</u></b>  Default=327 – (Second Sunday in March)  The format is MMRD, where MM = month (1-12), R = instance of the select day of the week (1-5 5=last instance), D = day of the week (1-7), where 1=Monday and</p>

First Menu Level Mode Number	Second Menu Level	Value Range	Mode Description and Instructions
45	21	111 – 3231	<p>7=Sunday.</p> <p>For example, 357 = the last Sunday in March, or 1117 = the First Sunday in November.</p> <p>If the value &gt;2000 then the right two digits represent the day of the month. The left two digits, minus 20, equal the month. For example, March 15th = 2315, April 1st = 2401.</p> <p>The day of the year derived from this rule is stored in Mode 52-1.</p> <p>See also Mode 45-21, Mode 45-22 and Mode 45-23.</p> <p><b><u>Daylight Saving Rule – End DST</u></b></p> <p>Default=1117 – (First Sunday in November)</p> <p>The format is MMRD, where MM = month (1-12), R = instance of the select day of the week (1-5 5=last instance), D = day of the week (1-7), where 1=Monday and 7=Sunday.</p> <p>For example, 357 = the last Sunday in March, or 1117 = the First Sunday in November.</p> <p>If the value &gt;2000 then the right two digits represent the day of the month. The left two digits, minus 20, equal the month. For example, March 15th = 2315, April 1st = 2401. The day of the year derived from this rule is stored in Mode 52-2.</p> <p>See also Mode 45-20, Mode 45-22 and Mode 45-23.</p>
45	40	0-9999	<p><b><u>Supervision Clock Address</u></b></p> <p>0-9990 (default=0)</p> <p>This address is used by the supervision/monitor program. Each clock must be set to a unique address.</p>
49	1-99 alarms	0-5	<p><b><u>Scheduled Alarm Toggle On/Off</u></b></p> <p>This mode is used to turn the alarm output on and off.</p> <p>0 = Deactivate alarm toggle output, 1 = turn on alarm output, 2 = turn off alarm output.</p>
50	1		<p><b><u>Restore Factory Defaults</u></b></p> <p>This special diagnostic mode is for factory use only. This mode is used restore the factory defaults.</p>
50	2		<p><b><u>Software Reset</u></b></p>

First Menu Level Mode Number	Second Menu Level	Value Range	Mode Description and Instructions
50	5		<p><u>This special diagnostic mode is for factory use only.</u> This mode is used to reset the software without removing power from the display.</p> <p><b><u>Restore-User Default Configuration</u></b>            This mode may be used to retrieve the custom configuration from memory if it was previously stored using mode 50-6. To execute the configuration retrieval process, press the mode button while 50-5 is displayed. The clock will resume normal operation after the configuration is retrieved.</p>
50	6	1-3	<p><b><u>Save-User Default Configuration</u></b>            This mode is used to store a custom configuration. Use mode 50-5 to restore the configuration. To execute the configuration save process, press the mode button while 50-6 is displayed. The clock will resume normal operation after the configuration is saved.</p>
52	1	1-365	<p><b><u>Custom Daylight Time Switch -User Defined 10</u></b>            Enter the day of the year to switch from standard time to daylight time. Both modes 52-1 and 52-2 must be set to the desired day of the year. See also Mode 45-20 to define new daylight saving rule. <b><u>Mode 45-20 must be set to 0 to enable this mode; otherwise, use Mode 45-20 to enable rule base switching.</u></b></p> <p>For U.S. Spring switch to Daylight Saving Time: 2010=73, 2011=72, 2012=71, 2013=69,2014=68, 2015=67, 2016=73, 2017=71</p>
52	2	1-365	<p><b><u>Custom Julian Standard Time Switch -User Defined 10</u></b>            Enter the day of the year to switch from daylight time to standard time. Both modes 52-1 and 52-2 must be set to the desired day of the year. See also Mode 45-21 to define new daylight saving rule. <b><u>Mode 45-21 must be set to 0 to enable this mode; otherwise, use Mode 45-21 to enable rule base switching.</u></b></p> <p>For U.S. Fall switch to Standard Time: 2010=311, 2011=310, 2012=309, 2013=307,2014=306, 2015=305, 2016=311, 2017=309</p>
53	1-20	01/01 to 12/31	<p><b><u>Alarm Schedule Date Range - Beginning Month/Day</u></b>            12/31 (default) - Set Mode 37-1=0 to enable. This mode is used to set the beginning month and day of an alarm date range. If Mode 54 has the same date, the alarm will activate only one day. If the Year in Mode 55 equals 2000, then the alarm will activate every year with the month/day range specified. The ending date must be occur after the beginning date. See also Mode 38 to force an alarm schedule active. Alarm group 1 is different than the other 19 alarm groups. If no date range is active,</p>

First Menu Level Mode Number	Second Menu Level	Value Range	Mode Description and Instructions
54	1-20	01/01 to 12/31	<p>then group is 1 the default. This feature reduces the number of alarm entries required in some schedule situations. Mode 27 set the hours and minutes. Mode 29 sets the day of the week (required).</p> <p><b><u>Alarm Schedule Date Range - Ending Month/Day</u></b> 12/31 (default) - Set Mode 37-1=0 to enable. This mode is used to set the ending month and day of an alarm date range. If Mode 53 has the same date, the alarm will activate only one day. If the Year in Mode 55 equals 2000, then the alarm will activate every year with the month/day range specified. The ending date must be occur after the beginning date. See also Mode 38 to force an alarm schedule active. Alarm group 1 is different than the other 19 alarm groups. If no date range is active, then group is 1 the default. This feature reduces the number of alarm entries required in some schedule situations. Mode 27 set the hours and minutes. Mode 29 sets the day of the week (required).</p>
55	1-20	2000 to 2050	<p><b><u>Alarm Schedule Date Range - Beginning Year</u></b> 2050 (default) - Set Mode 37-1=0 to enable. This mode is used to set the beginning year of an alarm date range. If the Year in Mode 55 equals 2000, then the alarm will activate every year with the month/day range specified. The ending date must be occur after the beginning date. See also Mode 38 to force an alarm schedule active. Alarm group 1 is different than the other 19 alarm groups. If no date range is active, then group is 1 the default. This feature reduces the number of alarm entries required in some schedule situations. Mode 27 set the hours and minutes. Mode 29 sets the day of the week (required).</p>
56	1-20	2000 to 2050	<p><b><u>Alarm Schedule Date Range - Ending Year</u></b> 2050 (default) - Set Mode 37-1=0 to enable. This mode is used to set the ending year of an alarm date range. If the Year in Mode 55 equals 2000, then the alarm will activate every year with the month/day range specified. The ending date must be occur after the beginning date. See also Mode 38 to force an alarm schedule active. Alarm group 1 is different than the other 19 alarm groups. If no date range is active, then group is 1 the default. This feature reduces the number of alarm entries required in some schedule situations. Mode 27 set the hours and minutes. Mode 29 sets the day of the week (required).</p>
74	1-99	0-255	<p><b><u>CELDSSS Radio NV Ram Parameter (factory use only)</u></b> <b>Prior to Ver. 1.36, use only clock buttons. Ver. 1.36 and later also allows changes using the Windows control program.</b> <b>This mode is write only.</b> Mode 74-n=y ; n=NV mode, y=value - change any NV ram</p>
75	1-6	0-255	<p><b><u>CEL DSSS Radio Functions (factory use only)</u></b> <b>Prior to Ver. 1.36, use only clock buttons. Ver. 1.36 and later also allows changes using the Windows control program.</b> <b>This mode is write only.</b> Mode 75-1=n - number of hops (10 default) Mode 75-2=n - transmit power level (17 default) Mode 75-3=n - 1=master (default), 2=slave, 3=both Mode 75-3=n - 1=master (default) with repeater mode disabled, 2=slave with repeater mode enabled, 3=both with repeater mode disabled. Mode 75-4=n - physical channel number 0-15 (14 default) Mode 75-5=n - logical channel (group) 0-15 (0 default) Mode 75-5=15 transmits and</p>

First Menu Level Mode Number	Second Menu Level	Value Range	Mode Description and Instructions
			receives on all channels. Mode 75-6=n - 1= reboots the radio , 2=restore initialization defaults

## **Ethernet Communications**

### **Overview**

Once the clock is connected to the network and power is applied, DHCP is used to automatically assign each clock an IP address on the network. The clock will then search the Internet or local area network for NTP time servers. NTP (Network Time Protocol) is a uniform method of sending time over a computer network. By default, the clock will automatically connect to the local network and attempt to act as a client to public or local SNTP time servers. SNTP is a subset of the NTP protocol. SNTP provides Universal Coordinated Time (UTC) to the clock. The clock then implements local time zone offsets and daylight saving rules to display the correct local time. The correct time will display within a few minutes of obtaining a time server lock. The clock includes a list of 8 Internet SNTP time servers. Local SNTP time servers may also be used. The clock includes a network web server which is used to configure various network communication parameters.

### **On LED digital clocks with a BRG network interface purchased after April, 2019, press the Up and Down buttons at the same time to display the Network IP and MAC addresses.**

Alternatively, using either the buttons on the clock or the remote control, press and hold mode button. The display will blink for a few seconds and then begin counting up. When the count reaches 9, release the button. The IP and MAC addresses will display. Enter the IP address into a web browser to access the Ethernet web configuration interface.

### **Ethernet Interface**

The Ethernet interface includes an easy to use web interface. Automatic address configuration (DHCP) is enabled by default. However, if a fixed network address will be used instead of DHCP, then the interface configuration will need to be changed.

### **Network Interface Configuration Web Interface**

The main page displays a variety of general information about the configuration and activity of the Ethernet interface.



## BRG Clock

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**Main Page**

<b>Clock Configuration:</b>	Configure clock-specific settings.
<b>Time Zone Configuration:</b>	Configure the local time zone and daylight savings settings.
<b>Network Configuration:</b>	Configure the network adapter.
<b>NTP Configuration:</b>	Configure the NTP servers.
<b>Change Password:</b>	Configure the logon password.
<b>Upgrade Firmware:</b>	Upgrade firmware.

---

**Status**

Current Time: 2020/07/24-13:45:18  
Last NTP Synchronization Time: 2020/07/24-13:44:58

**Ethernet**

MAC Address: 00-FF-1C-53-A6-19  
IPv4 Addresses: 192.168.22.26  
IPv4 Mask: 255.255.255.0  
IPv4 Gateway: 192.168.22.20  
DNS1: 192.168.42.8  
DNS2: 192.168.42.7  
DHCP Lease Timeout: 480 min

Up Time: 0 d 17 h 19 m 36 s  
Firmware Version: 1.0.28.0

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## User Name and Password

The menu in the left column allows selecting several sections of the interface. A user name and password is required to enter any section other than the main page.

The default user name is: **user**

The default password is: **password**

The user name and password should be changed after installation. Store the user name and password in a safe location for later reference.

## Clock Configuration



## BRG Clock

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**Clock Settings**

Clock Name:  (max. 20 characters)

SNTP Sample Interval:  (1-1440 minutes)

SNTP Extra Random Delay:

SNTP Random NTP Server:

UDP Destination Address:  255.255.255.255 = broadcast  
0.0.0.0 or blank = disabled

UDP Time Port:  (1024-65535)

UDP Discovery Port:  (1024-65535)

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Clock Name - is the user defined name used to identify the device during a network search.

SNTP Sample Interval - is the time in minutes between SNTP time updates. The default is one minute.

SNTP Extra random delay – if this box is checked, a random delay will be added to the sample period so that all clocks do not attempt to access the time server at the same time.

SNTP Random NTP Server – When this box is checked, the NTP server will be randomly selected from the configured list.

UDP Destination Address – is the IP address for the clock to send responses to, typically the control PC.

UDP Time Port – default 16000, for UDP time broadcasting, not usually used for SNTP time acquisition.

UDP Discovery Port - default 16001, for UDP commands and discovery by the Windows control program.

Click on the Apply button to save changes.

**Analog clock Ethernet configuration.**

**DO NOT USE WITH DIGITAL CLOCKS**



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**Time Zone Settings**

Time Zone:  (±hhmm - hours/minutes ahead/behind GMT)

-0800 = US Pacific  
 -0700 = US Mountain  
 -0600 = US Central  
 -0500 = US Eastern  
 +0000 = Western Europe / GMT  
 +0100 = Central Europe

Daylight Savings Time:  Enable  Disable

DST Begin Month:

DST Begin Date:  Second   (1-31)

DST Begin Hour:  (0-23)

DST End Month:

DST End Date:  First   (1-31)

DST End Hour:  (0-23)

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**DO NOT USE WITH DIGITAL CLOCKS**

The network interface provide UTC time to digital clocks. Time displays rules are configured in each digital clock. For analog clocks, time displays rules are configured in the Ethernet interface.

BRG can preconfigure the clock’s time display rules at the factory.

1. Connect the clock to the Power over Ethernet capable network.
2. Read the IP address from the digital display on the back of the clock.
3. Enter the IP address into a web browser to access the Ethernet web configuration interface.
4. Click on “Time Zone Configuration” from the menu on the left
5. Enter the username: “user” and password: “password” when prompted.
6. Enter the desired time display rules
7. Click on the “Apply” button at the bottom of the page.
8. If needed, change the NTP server information by clicking on “NTP Configuration”.
9. Press the reset button on the clock to reset the hands and update the time.

Another method of configuring the Ethernet interface is to connect the PC directly to the Ethernet interface. All network connections must be disabled on the computer except "Local Area Connection". Right click on the network icon at the bottom of the screen. Click on “Open Network Connections”, or go to, Start > Control Panel > Network Connections. If "Local Area Connection" is not the only enabled connection, right click on the other connections and click on disable.

## Network Configuration



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Network Configuration

**IP v4 Settings**

Enable DHCP

IPv4 Address:

Subnet Mask:

Default Gateway:

Primary DNS:

Secondary DNS:

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Enable DHCP – check to enable automatic IP address configuration using DHCP. Uncheck to use manual address configuration. The address fields will be grayed out when checked.

IP v4 Address – enter the IP address using version 4 protocol

Subnet Mask – enter the subnet mask

Default Gateway – enter the gateway IP address

Primary DNS – Domain Naming Service address - required if one or more alphabetic named Sntp servers will be used. Not required if all Sntp server addresses are numeric.

Secondary DNS - Domain Naming Service address - optional

The factory default addressing mode is DHCP. If your network has a DHCP server, simply connect the clock to your network and the clock will acquire a leased IP address. The lease acquisition can be almost immediate or may take several minutes. You can use the Clock Control program to determine the leased IP address by going to Setup/Clock IP Discovery. You may not see your clock listed in the discovery panel until it has acquired a lease. You cannot access the Ethernet interface until it's acquired an IP address. Once the clock has acquired an IP address, you then select the clock from the discovery listing by clicking on it. Then click the browse button to open a session to the Ethernet interface.

### Failure to Connect –

If the IP address is misconfigured or the clock cannot connect to the network using DHCP auto IP assignment, then after a few minutes, the clock will be assigned an IP address of 169.254.x.x where x is a random value from 1 to 254. If DHCP has been disabled and the fixed IP address is misconfigured, then the IP must be discovered using a PC.

**Clocks purchased after April, 2019**

To display the clock’s IP and MAC address on the clock, using either the buttons or remote control, press and hold mode button. The display will blink for a few seconds and then begin counting up. When the count reaches 9, release the button. The IP and MAC addresses will display. Enter the IP address into a web browser to access the Ethernet web configuration interface.

The firmware has address conflict resolution. So if two or more units are assigned the same IP, when subsequent units come online they default to an auto IP address (169.254.x.x)

**SNTP Time Servers**



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**SNTP Servers**

	Server Name	
1	<input type="text" value="tick.usno.navy.mil"/>	IP address: 123.234.45.56
2	<input type="text" value="tock.usno.navy.mil"/>	
3	<input type="text" value="time.google.com"/>	
4	<input type="text"/>	
5	<input type="text"/>	
6	<input type="text"/>	
7	<input type="text"/>	
8	<input type="text"/>	

In each field, enter the hostname (e.g. ntp.usno.navy.mil) or IP address (e.g. 192.5.41.42) of an SNTP time server. At least one DNS server must be configured for hostnames to resolve correctly (see the "Network Configuration" page). If no DNS servers are configured, only numeric dotted IP addresses will function.

PLEASE NOTE: If an invalid DNS server is entered on the "Configuration" page, the system may become slow and unresponsive. Please ensure that the DNS server settings are correct. If there are no DNS servers available, make sure that the "Primary DNS" and "Secondary DNS" fields are empty.

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Server Name – enter the numeric IP addresses or alphanumeric named addresses of the desired network time servers. The default configuration includes ten government time server addresses.

Once the clock has an IP address it will attempt to contact the first SNTP time server in the list. If the network firewall prevents the clock from reaching the Internet, change the SNTP addresses listed to only local network SNTP time servers. Remove any server addresses outside the local network.

**Security**



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Security

Enter Old Password:

Enter New Username:  Leave this box empty if no user name change required.

Enter New Password:  Leave this box empty if no password change required.

Confirm New Password:  Leave this box empty if no password change required.

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Change the password as needed. Be sure to store in a safe location for future reference. Click on the Apply button to invoke the change.

## Upload Firmware



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Upload Firmware

Upload a new firmware image into flash.  
(A firmware image file must begin with "BRG\_Clock" and end with a ".bin" extension.)

Current FW Ver: 1.0.28.0

Select Image:  No file chosen

---

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The factory may provide a file to update the firmware in the Ethernet interface. The Update Firmware screen facilitates the update process.

## Restore Ethernet Interface

To restore the Ethernet interface back to factory defaults, press and hold the yellow mode button. The display will slowly begin counting up. When the count reaches 8, release the mode button and momentarily press the blue TC button.

## Time Synchronization Problems

If your clock is not synchronizing with an Internet SNTP time server, check the following items:

- The NIC must have a valid DHCP or fixed IP address.
- The NIC must be in the SNTP operating mode.
- If you are using fixed IP addressing, the clock must have the correct gateway address to access the Internet. The gateway is the first router that the clock must go through to access other networks or the Internet.

- Your network firewall must allow the clock to access the Internet through port 123.
- The clock must have the default NTP time server IP address loaded into the NIC.
- If using named SNTP servers, be sure a valid DNS address is provided, or use only numeric SNTP server addresses.

If your clock is not synchronizing with a local network NTP time server, check the following items:

- The NIC must have a valid DHCP or fixed IP address.
- The NIC must be in the SNTP operating mode.
- If you are using fixed IP addressing, the NIC must have the correct gateway if the server is on another network. The gateway is the first router that the clock must go through to access other networks.
- The correct NTP time server IP address must be loaded into the NIC.
- If using named SNTP servers, be sure a valid DNS address is provided, or use only numeric SNTP server addresses.

### **Technical Support**

For BRG Technical Support, call 1-316-788-2000, 8am-5pm, U.S. Central time, or email [www.support@brightclock.com](mailto:www.support@brightclock.com).

## Communications Protocol

The time, date and data string is 35 bytes long, beginning at position 0

begin data string - position 0, length 1: "\*"

position 1, length 2: seconds

position 3, length 2: minutes

position 5, length 2: hours

position 7, length 2: day

position 9, length 2: month

position 11, length 4: four digit year

position 15, length 4: RC60 movement second motor control, start and stop hours

position 19, length 5: reserved

position 24, length 1: 1=normal time packet,

5=time zone packet,

8=CDMA packet,

9=GPS packet

position 25, length 1: alarm master/slave - 0=invalid, 1=alarm on, 2=alarm off

position 26, length 1: reserved

position 27, length 1: reserved

position 28, length 2: analog clock radio power on time in seconds

position 30, length 2: when position 24=5, time zone display zone number

position 32, length 1: analog clock power saving mode, 0=disabled, 1=enabled

position 33, length 1: when position 24=5, 1=save time zone number (see mode 37-10)

end data string - position 34, length 1: "#"

## Wireless GPS and Ethernet GPS Time Receivers



The GPS satellites obtain their time from the U.S. Atomic time standard, providing legally traceable time to the wireless clock system. Two GPS models are available. The RC161 receives GPS time and sends it wirelessly to all master clocks within radio range. The MCR100GPS receives GPS time and sends it over the computer network to any number of master clocks.

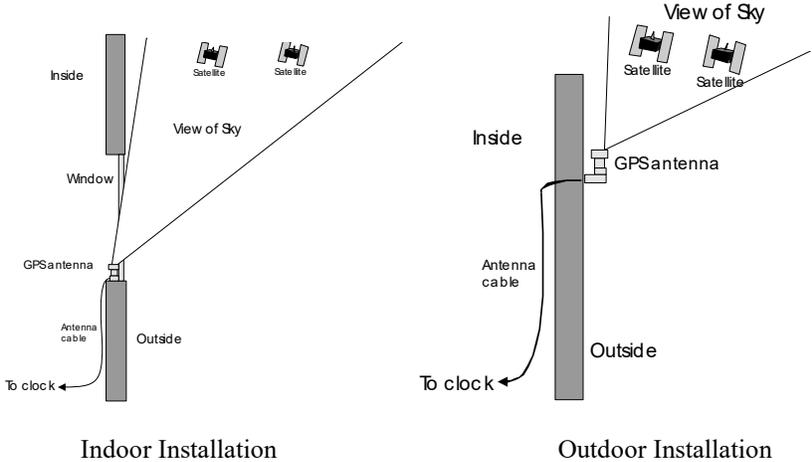
The RC161 wireless GPS receiver assembly consists of two modules: GPS receiver and wireless transceiver. The GPS receiver mounts in a location that has a view of the sky, while the wireless transceiver is normally located indoors. The GPS receiver acquires time data from the GPS satellites and sends it to the indoor wireless transceiver over a cable. The wireless transceiver converts the time data to secure time packets and broadcasts the data to the wireless network once per minute. The wireless transceiver must be located with 150 feet of at least one RC100 master clock (330 feet in open space construction). Repeaters may be used to extend this range. As soon as the GPS receiver obtains a time lock, the transceiver will begin broadcasting time to the master clocks.

The MCR100GPS consists of two modules, the GPS receiver and Ethernet NTP time server. The receiver acquires time data from the GPS satellites and sends it to the Ethernet NTP time server. The time server decodes the raw GPS time broadcasts and sends the data to one or more master clocks over the computer network. A status LED will blink when the interface receives valid time packets from the GPS receiver.

The RC100 master clock includes an indicator on the right side of the display to indicate when the clock has received time updates from either a wireless GPS receiver (G\*) or an NTP/GPS network time update(E\*). Once the clock locks onto the time signal, the sync indicator will remain on. If sync reception is lost for more than two hours, the sync indicator will turn off.

There are normally several satellites overhead at any point in time. The GPS antenna may be mounted indoors on a windowsill. This mounting method allows a partial view of the sky, which is enough to receive 2 to 3 satellites. The antenna may also be placed below a skylight. The

GPS antenna is water tight and may be mounted outdoors, on a roof or exterior wall. The following diagrams illustrate antenna positioning:



**GPS Receiver Specifications**

Specifications	Parameter	Description
General		L1 frequency, C/A code (SPS) 32 independent tracking channels
Sensitivity		-158 dBm
Acquisition	Cold start Warm start Hot start	41 seconds (typical) 35 seconds (typical) 1 second (typical)
Reacquisition		100 ms (typical)
Dynamics	Altitude Velocity Vibration	18,000m max. 500 m/sec. 4G max.
Operating Temperature		-30C to +80C
Storage Temperature		-40C to +85C
Operating Humidity		0% to 95% RH, non-condensing
Water Resistance		100% waterproof
Primary Power		8V to 35V DC
Power Consumption		34mA to 44mA @ 12 V DC
Protocol		NMEA-0183 v3.01 4800 baud
Signal Level		RS232 to the cable adapter, then RS422
NMEA Message	Default	RMC, GGA, GSV*5, VTG, GSA*5
	Update Rate	1 Hz
DGPS Capability		RTCM protocol
EMI filter		Rejects power line interference
SBAS		1 channel (supports WAAS, EGNOS, MSAS)
Power Cable		UL2464/ 24AWG, 45 feet (15M) to the cable adapter, then CAT-5E
Enclosure		High impact, corrosion-proof polycarbonate resin
Connector		7 pin circular, hermetically sealed. Gold plated contacts.
Dimensions	GPS Receiver Mounting Base	80mm (Ida.) x 71.3mm (H) 110mm(W) x 70mm (L) x 75.2mm (H)
Weight		150 grams (without cable)

This specification is subject to change without notice

# Warranty Agreement

## BRG Precision Products One Year Warranty

### **1. Term of Coverage**

Coverage will be for 1 year. Claims must be made during the Warranty Period. This Agreement is not renewable. The warranty becomes null and void if complete payment is not made within the terms specified under Terms of Payment.

### **2. Warranty**

BRG Precision Products, Inc. warrants the Product against defects in workmanship and materials during the Coverage Period. BRG Precision Products, Inc. further warrants that DuraTime wireless products will not interfere with properly operating WLAN/WiFi products, or that properly operating WiFi, Bluetooth, or Wireless USB devices will not interfere with DuraTime wireless products.

### **3. Coverage**

BRG Precision Products, Inc. will, at its option, repair or replace the defective Product free of charge, provided that you notify BRG Precision Products, Inc. of the Product defect within the Coverage Period, and provided that BRG Precision Products, Inc. through inspection establishes the existence of such a defect and that it is covered by this Agreement. BRG Precision Products, Inc. will, at its option, use new and/or reconditioned parts in performing warranty repair and building replacement products. BRG Precision Products, Inc. reserves the right to use parts or products of original or improved design in the repair or replacement. If BRG Precision Products, Inc. repairs or replaces a Product, the warranty continues for the remaining portion of the Coverage Period without extension. All replaced Products and all parts removed from repaired Products become the property of BRG Precision Products, Inc. BRG Precision Products, Inc. covers both parts and labor necessary to repair the Product, and return shipment to the Customer via a BRG Precision Products, Inc.-selected non-expedited surface freight within the contiguous United States and Canada. Alaska and Hawaii return shipments to the Customer are via non-expedited air freight.

### **4. What Is Not Covered**

This Agreement does not cover costs related to the removal, installation, or field troubleshooting of the Product under the terms of the Agreement if, and not limited to:

- a) the Product has been misused, neglected, improperly installed, physically damaged or altered, either internally or externally, or damaged from improper use or use in an unsuitable environment;
- b) the Product has been subjected to fire, splashed water (unless specifically ordered to be water resistant), submersion into any liquid, generalized corrosion, biological infestations, or high input voltage including lightning strikes and generators operating outside the limits of their Product specifications;
- c) repairs have been done to it other than by BRG Precision Products, Inc. or its authorized service centers, or as assigned by BRG Precision Products;
- d) the Product is used as a component part of a Product expressly warranted by another manufacturer;
- e) the Product's original identification (trade-mark, serial number) markings have been defaced, altered, or removed;
- f) the customer has misrepresented the Product information provided to BRG Precision Products, Inc. in order to receive coverage under the terms of this Agreement. This Agreement does not warrant uninterrupted or error-free operation of the Product;
- g) Product malfunction or damage resulting from electromagnetic or solar radiation;
- h) Shipping charges to the factory more than 30 days after first receiving the product;
- i) Normal wear and tear relating to the non-operating functions of the equipment such as discoloration from direct sunlight, heat, etc.

### **5. Disclaimer and Limitation of Liability**

TO THE EXTENT PERMITTED BY APPLICABLE LAW, OTHER THAN THE EXPRESS WARRANTY SET FORTH IN THIS AGREEMENT, BRG PRECISION PRODUCTS, INC. MAKES NO ADDITIONAL WARRANTIES, EXPRESS OR IMPLIED, AND DISCLAIMS ALL IMPLIED WARRANTIES, WHETHER IN FACT OR BY OPERATION OF LAW, STATUTORY OR OTHERWISE, INCLUDING WARRANTIES OR CONDITIONS OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. ANY

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**6. Claim Limits**

Claims are limited to repair or replacement, or if in BRG Precision Products, Inc.'s discretion that is not possible to reimbursement up to the purchase price paid for the Product. In no event will BRG Precision Products, Inc.'s liability under this Agreement exceed the purchase price paid for the Product.

**7. Cancellation**

You may cancel this Agreement by providing to BRG Precision Products, Inc. written notice of your wish to cancel.

**8. Insurance**

This Agreement is not a contract of insurance.

**9. Amendment and Waiver**

No amendment, supplement, consent or waiver, express or implied, to or of any provision of this Agreement will be effective unless in writing signed by the parties hereto and then only in the specific instance and for the specific purpose given.

**10. Assignment**

The Customer may assign or transfer this Agreement provided BRG Precision Products, Inc. is advised by the Customer in writing of such assignment and the new system owner's information.

**11. Governing Law**

This Agreement will be governed by and interpreted exclusively in accordance with the laws of the State of Kansas, without reference to provisions concerning conflicts of laws. The provisions of the United Nations Convention on Contracts for the Sale of Goods are hereby excluded.

**12. Arbitration**

Any controversy or claim arising out of or relating to this Agreement, or the breach of it, shall be settled by arbitration in accordance with the relevant rules of the American Arbitration Association, and judgment on the award rendered by the arbitrator may be entered in any court having jurisdiction thereof. The place of arbitration shall be Wichita, Kansas, United States of America. There shall be one arbitrator.

**13. Severability**

If any provision of this Agreement is found by any court or arbitrator to be invalid, illegal or unenforceable, the validity, legality and enforceability of the remaining provisions will not be affected thereby.

**14. Entire Agreement**

This Agreement constitutes the entire contract between the parties concerning the subject matter of this Agreement and supersedes all marketing brochures and other expectations, understandings, communications, representations and agreements, whether verbal or written, between the parties. THIS AGREEMENT GIVES YOU SPECIFIC LEGAL RIGHTS AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE.

Once a return authorization number is obtained, ship the products to:

**BRG Precision Products**  
**Attn: RA# xxxxxxxx (where xxxxxxxx is the authorization number provided)**  
**600 N. River**  
**Derby, KS 67037**

**Optional Extended Warranty:**

A two-year extended warranty is available. The extended warranty must be purchased before the end of the standard warranty. The two-year extended warranty costs 20% of the product purchase price.

**30 Day Return Policy:**

No returns will be accepted without prior written authorization of BRG. Incorrect merchandise received will receive prompt re-shipment of correct items. Incorrect merchandise, other than custom items, may be returned, shipped prepaid, and will be exchanged on an equivalent basis.

Merchandise, other than custom items, that cannot be used may be returned at a 25% restocking charge if items are shipped prepaid in the original boxes. Carrier is responsible for parts damaged in shipment. The customer should have driver sign for damaged carton on delivery receipt and make a claim with the freight company. Please insist that the carrier's representative conduct an inspection, and retain all packing materials for the inspector. Please report promptly for immediate follow-up on short shipments. No action arising from any sale by BRG may be brought by a customer more than one year after the date of shipment.

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**Terms of Payment:**

New accounts require prepayment. International orders require prepayment by Telegraphic Transfer (bank wire). For established customers, payment is due in full within 30 days from invoice date. Other payment methods include Visa, Mastercard, American Express, Discover, Novus (Domestic Only). Add 4.75% for ground shipping in the U.S. and Canada. Domestic shipping is prepaid for U.S. Government orders. Other shipping methods are available. All past due accounts will be subject to a finance charge of 1.5% per month. BRG may cancel or delay future deliveries if customer fails to make prompt payment or if customer's financial condition warrant such action in BRG's opinion. BRG is not responsible for delays. The customer will be contacted and given the choice of receiving a partial shipment or waiting for the full shipment. The firmware license may be suspended, limiting functionality of the equipment, if payment is not received within 90 days.

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**Pricing:**

BRG Precision Products reserves the right to change prices without prior notification. Prices do not include taxes and BRG reserves the right to arrange for insurance on all orders.

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The courts of Sedgwick County, Kansas will have exclusive jurisdiction and venue over any disputes arising from any sale by BRG and customer and Buyer consent to personal jurisdiction of the federal and state courts located in Sedgwick County, Kansas. If legal action is brought by BRG for the collection of any amount owed or due to any other dispute, the prevailing party will be entitled to recover its reasonable attorneys' fees and costs incurred. These items constitute the entire agreement between BRG and customer, regardless of any additional or conflicting terms on customer's purchase order or other documentation, which are objected to, or any prior discussions or usages of trade. All sales by BRG are made only on the terms and conditions contained herein.

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