
RADIO SYSTEMS INC.
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Digital Microprocessor Master Clocks and Timers

"SUPER CLOCK"

OPERATING MANUAL

Contents

OVERVIEW	1	1
The "Super Clock" system	1	1.1
"Super Clock" system components	1	1.2
The "Super Clock" options	2	1.3
Illustration 1.1 - Clock Features	3	
OPERATION	4	2
POWER UP	4	2.1
CLOCKS	4	2.2
Setting the clock	4	2.2.1
Starting the clock	4	2.2.2
TIMERS	4	2.3
Up timing	4	2.3.1
Down timing (requires optional keypad)	5	2.3.2
"Master" - "Slave" Timer operation	5	2.3.3
CLOCK/TIMERS	5	2.4
Entering the time of day via the optional keypad	5	2.4.1
Starting the clock via the optional keypad	5	2.4.2
ANALOG CLOCKS	6	2.5
Setting an individual clock	6	2.5.1
Illustration 2.1 - Clock/Timer Controls	7	
Illustration 3 - Keypad Instructions	8	
SYSTEM CONFIGURATION	9	3
TIME BASE SELECTION (clocks and clock/timers only)	9	3.1
Standard crystal	9	3.2
TCXO	9	3.3
SYNCHRONIZATION	9	3.4
Line synchronization	9	3.4.1
External synchronization	9	3.4.2
No synchronization	10	3.4.3
"Master"-"Slave" clock operation	10	3.5
Master-Slave system design - via serial data links	10	3.5.1
Master-Slave Timer Operation	10	3.5.2
Offsetting the "slave" time display	10	3.5.3
REMOTE CONTROL AND INSTALLATION OF OPTIONS .. 11	11	4
SERIAL WIRING	11	4.1
Wiring scheme	11	4.1.1
Master slave clock wiring	11	4.1.2
Master slave timer wiring	11	4.1.3
Analog clocks	11	4.2
Illustration 4.1 - Clock/Timer System Configuration	12	

Illustration 4.2 - System Wiring	13	
RACK MOUNTING	14	4.3
Units with .53" displays	14	4.3.1
Units with 2.25" displays	14	4.3.2
DIP SWITCH SETTINGS	14	4.4
Transmit termination switch position 1	14	4.4.1
Receive termination switch position 2	14	4.4.2
Down time stop at zero switch position 3	14	4.4.3
12/24 hour switch position 4	14	4.4.4
Switch Position 5	14	4.4.5
Switch position 6 - clocks and clock/timers only	14	4.4.6
WIRING	15	4.5
Remote control wiring	15	4.5.1
Illustration 4.3 - Desktop Remote Connections	17	
Illustration 4.4 - 2" Remote Connections	18	
Illustration 4.5 - In-Console Remote Connections	19	
ELECTRONIC ADJUSTMENTS	20	4.6
Time Base Frequency Adjustment	20	4.6.1
SPECIFICATIONS	21	5
Power	21	5.1
Time base	21	5.2
Synchronization	21	5.3
Serial Data	22	5.4
Display type	22	5.5
Controls and switches	23	5.6
"Super Clock" Console Field Installation	24	6
Illustration 6.1 - Desktop Options	24	
Illustration 6.2 - 2" Options	25	
Illustration 6.3 - In-Console Options	26	
Illustration 6.4 - Console Field Installation	27	
Warranty		

OVERVIEW

1

The Radio Systems digital "Super Clock" series consists of desk-top and wall-mount clocks and timers which can be interconnected to form various user-configured timing systems. Radio Systems analog impulse clocks can also interface with the system.

1.1

THE "SUPER CLOCK" SYSTEM

Any clock may serve as a master or slave.
 Any clock can accept an external 1 or 10 Hz serial or line reference synchronization.
 Any clock may utilize an internal crystal reference (standard feature) or an optional internal super-accurate TCXO reference.
 Any clock can drive up to six wall-mount analog impulse clocks.
 Any "slave" clock will automatically switch to independent operation if it loses its external time base reference.
 Any slave clock can be offset by any number of whole hours to display a different time zone.
 Any timer can function as an up-timer or (with the optional keypad) as a programmable down-timer.
 Any timer can function as a remote display for another timer.

1.2

"SUPER CLOCK" SYSTEM COMPONENTS

Model	Description
DTCT-6	Tabletop clock and up/down timer with two 6-digit 1/2" LED displays.
DTC-6	Tabletop clock only with one 6 digit 1/2" LED display
DTT-6	Tabletop up/down timer with one 6 digit 1/2" LED display
DWC-6	Wall-mount clock only with one 6 digit 2" LED display
DWT-6	Wall mount up/down timer with one 6 digit 2" LED display
AMD-1	Analog clock driver to drive up to 50 analog clocks. Stands alone, or accepts sync from any digital clock. Provides daylight savings and standard time analog clock adjustments
AC-12	12" analog impulse clock. Can be driven from any digital clock display or from AMD-1 driver.

THE "SUPER CLOCK" OPTIONS

Model	Description
TCXO Crystal	For super accuracy. Installs in any digital clock or AMD-1 impulse driver.
Lead Acid Battery	For extended back-up. Installs in any digital clock (standard in AMD-1 impulse driver).
KP-CT	Keypad to enter timer down times and optional method to control and set clocks and up timer.
MT-1	Rack Mount for all tabletop displays
MT-2	Rack or wall mount for 2" displays

Clock Features I/O / Timbase / Remote Control / Power

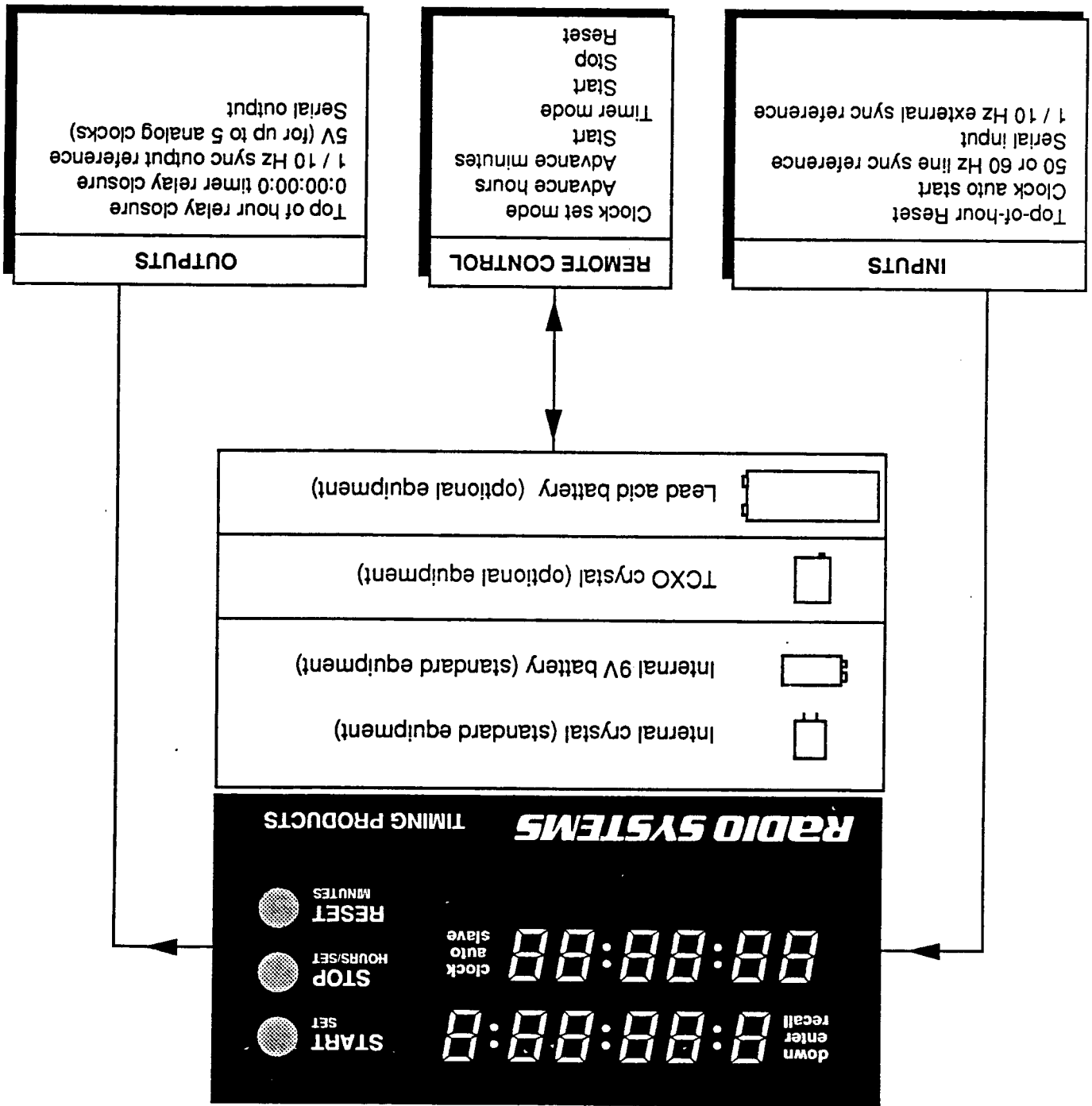


Illustration 1.1 - Clock Features

OPERATION

2

POWER UP

2.1

The "Super Clock" system operates from standard A.C. power. No power switches are provided. In addition, units with a clock display contain a battery to maintain proper time during a power failure. Remove A.C. power by unplugging the power cord, and disconnect the internal 9 volt battery by removing it, or by removing the rear panel battery fuse (only with optional lead acid).

Note: Units are shipped with a 9 volt battery holder only or with the optional lead acid battery fuse removed.

When the unit is powered up the displays will illuminate. Timer displays will remain at 0:00:00:0. Clock displays will start at 12:00:00 and begin counting. If the unit is wired as a "slave", the displays will follow the master.

CLOCKS

2.2

Setting the clock

2.2.1

Press start and stop simultaneously until the clock lamp illuminates (approximately 3 seconds). The auto lamp will also illuminate. Then release both buttons. Press and hold the stop button to advance the hours display. Press and hold the seconds display.

Starting the clock

2.2.2

Press the start button to start the clock and exit the clock set and auto start modes. Alternately a momentary remote closure on remote pin 18 will start the clock as long as the auto lamp was previously illuminated.

TIMERS

2.3

Up timing

2.3.1

Start button - causes the timer to start or resume counting up

Stop button - causes the timer to stop and hold the displayed time

Reset button - causes the display to clear to 0:00:00:0 and hold (if reset from the stop mode) or resume counting (if reset from the start mode).

Note: Start, stop, and reset on the optional keypad or on the remote connector will perform the same functions.

Down timing (requires optional keypad)	2.3.2
<p>Entering a down time - Key in any five valid digits up to 9:59:59. Tenth's are not entered (they are preset to "0"). Ninety seconds is entered as 1:30. Time is entered left-hand digit first, and will scroll across the display as entered. The front panel "down" lamp will illuminate.</p>	
<p>Start down timing - Pressing start will initiate the down timing function. If an invalid time was entered (e.g. - 70:99), pressing the start button will clear the display.</p>	
<p>Stop down timing - Pressing stop will cease the down timing function and hold the display.</p>	
<p>Reset down time - Pressing the reset button once will return the display to the last entered down time and hold the display. The start button may be pushed to begin down timing. Pressing the reset button a second time will return the display to 0:00:00 and exit the down timing mode.</p>	
<p>Storing presets - Up to 10 down times may be stored in down time memory locations 0 - 9. Enter a valid down time up to 9:59:59. Press enter (the enter lamp will illuminate) followed by button 0 - 9 to select the desired memory location. Repeat to store up to nine more times.</p>	
<p>Recalling preset - Press enter (the recall and down lamps will illuminate) followed by button 0 - 9 to recall the desired time from memory. Press start to initiate down timing.</p>	
"Master" - "Slave" Timer operation	2.3.3
<p>A "slave" clock or timer unit properly wired to a "master" unit will light its "sync" lamp and its display will exactly follow the master readout. Note that the 10th digit on slave timers will not illuminate as this digit does not synchornize to the master. In dual clock/timer units operating as slaves, the clock or timer display will function independently if there is no "up-stream" master unit. Timer-only units in a serial link will pass clock information on down the line.</p>	
CLOCK/TIMERS	2.4
<p>Combination clock/timers operate as noted above with the following exceptions:</p>	
Entering the time of day via the optional keypad	2.4.1
<p>Press the clock button. The clock lamp will illuminate. Enter the time via the keypad. Hours, minutes and seconds may be entered (in that order). Invalid times will not be accepted.</p>	
Starting the clock via the optional keypad	2.4.2
<p>Press start and the clock will start and the clock lamp will extinguish. If an auto start from the remote control is desired push the auto button and the auto lamp will illuminate. Pressing the clock button will leave the clock display holding for an auto start but will return the keypad to timer functions.</p>	

ANALOG CLOCKS

2.5

Analog clocks may be wired to digital clocks for power and timing signals.

Note: When ever power is applied to an analog clock, each clock must be allowed to run for a minimum of 2 seconds so that it will adapt to the system.

Setting an individual clock

2.5.1

- A. With the digital clock running, and displaying the proper time, start the analog clock (if necessary) by pushing the start/stop button located on the rear of the analog clock.
- B. When the second hand reaches "12" push the start/stop button stopping the analog clock.
- C. Set the time on the clock one minute ahead of the time displayed on the digital clock.
- D. When the time on the digital display equals the time displayed on the analog clock, push the start/stop switch on the rear of the analog clock, starting the analog clock.

Clock/Timer Front Panel Controls

Illustration 2.1 - Clock/Timer Controls

TIMER CONTROL

Press the start button to begin up timing.

Press the stop button to stop and hold timer display.

Press the reset button to return the timer display to 00:00:00.

Press the auto button to allow auto start of timer and clock functions. The auto lamp will illuminate.

These controls used when installed in RS-series console

START	
STOP	
RESET	
AUTO	



CLOCK CONTROL

Press start and stop together and hold to enter the clock set mode. Auto and clock lamps will illuminate and the display will reset to 0:00:00.

Press and hold the stop button to advance the hours display.

Press and hold the reset button to advance the minutes display.

Press the start button to exit the set mode and start the clock, or, the clock may be remotely started via a closure to remote control pin 18.

Keypad Operating Instructions

Key in any five digits up to 9:59:59. Do not enter tenths (they are preset to "0"). Invalid times (eg - 9:79:79) will not be accepted. Time is entered left-hand digit (hours) first, and will scroll across the display as entered. The front panel "down" lamp will illuminate.

Start timing - Pressing start will initiate the timing function. If an invalid down time was entered (eg - 9:70:99) pressing the start button will clear the display.

Stop timing - Pressing stop will cease the timing function and hold the display.

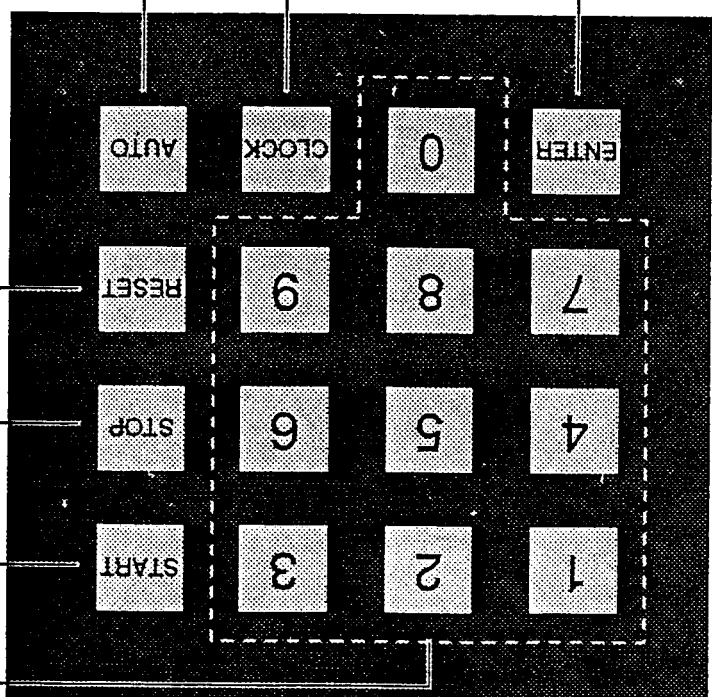
Reset time - Pressing the reset button once will clear an up-time or return the display to the last entered down time and hold the display. The start button may now be pushed again to begin timing. When down-timing, pressing the reset button a second time will return the display to 0:00:00 and exit the down timing mode.

Auto start - Push the auto button to enable clock or timer start via a remote closure to pin 18 of the remote connector. The auto lamp will illuminate.

Set time of day (for units with clock displays only) - Press the clock button. The clock lamp will illuminate. Enter the time via the keypad in hours/minutes/seconds order. Press the start button to start the clock (invalid times such as 9:79:79 will be rejected). For an auto-start clock command, press the clock button again. The display will hold for an auto-start command and return the keypad timer functions.

Storing presets - Up to 10 down times maybe stored in down time memory locations 0 - 9. Enter any valid down time up to 9:59:59. Press enter (the enter lamp will illuminate) followed by button 0 - 9 to select the desired memory location.

Recalling presets - Press enter (the recall lamp will illuminate) followed by button 0 - 9 to recall the desired time from memory. Press start to initiate down timing.



SYSTEM CONFIGURATION

3

3.1 TIME BASE SELECTION (clocks and clock/timers only)

The clock contains an internal time base, driven by either the standard crystal or optional TCXO. This internal time base may be synchronized to a more accurate external 1Hz or 10Hz signal, or to the power line if so desired. If the external synchronization signal is interrupted, the unit will revert to its internal time base. In addition, if a unit is used as a "slave" clock display the serially received time of day signal will override the internal time base and any synchronization signal. If the serial time data is interrupted the unit will revert to its internal time base.

3.1

STANDARD CRYSTAL

The system may utilize the standard crystal as the time base. The top cover of the unit may be removed to verify that the optional TCXO time base has not been installed.

3.2

TCXO

The system may utilize the optional TCXO as the time base. The top cover of the unit may be removed to verify that the optional TCXO module has been installed.

3.3

SYNCHRONIZATION

The internal crystal or TCXO time base may be synchronized to an external signal.

3.4

Line Synchronization

The system can utilize a 50 or 60 Hz A.C. line frequency for normal operation and will automatically switch to the internal crystal during a power failure.

3.4.1

Set dip switch 6 to the on position to enable this mode of operation.

3.4.2

External Synchronization

The system will utilize an externally supplied synchronization signal and revert to either the standard crystal or to the TCXO as a backup in the event that the external synchronization signal is interrupted.

An external 1 Hz or 10 Hz synchronization signal may be connected to the clock as follows:

Terminal 16* on the remote control allows connection of an unbalanced logic level ground referenced signal. The signal should be positive going and when high should be between 3 and 24 volts.

Terminals 14* and 15* on the remote control is an opto-isolated input for the connection of balanced or alternating polarity signals. The signal should be between 10 and 24 volts. When utilizing terminals 14 and 15 to opto-isolate a unipolar signal, terminal 14 is positive and terminal 15 is negative.

3.4.3 No synchronization

If no external synchronization signal is required, the internal crystal or TCXO will be used as the time base. Make no connections to pins 16*, 14*, or 15* on the terminal strip. Turn dip switch position 6 to off.

*NOTE - Do not use these terminals for in-console clocks, the pin-outs are different. Please refer to Illustration # 4.5.

3.5 "MASTER"- "SLAVE" CLOCK OPERATION

When a slave clock is powered up, its sync lamp will illuminate and its display will follow the master. If serial data is interrupted, the sync lamp will extinguish and the clock will revert to local operation.

A clock that is not in "slave" mode (sync lamp not illuminated) may function independently, or serve as the master for the system.

3.5.1 Master-Slave system design - via serial data links

Any digital clock or timer in the system can function as a master or slave display.

Both clocks and timers will recognize serial data provided them from an "up-stream" clock or timer in the system and switch to slave operation.

3.5.2 Master-Slave Timer Operation

To allow the intermixing of timers in a system that follow a master timer display or allow local timing, pins 8 and 9 (time stop and reset control) must be connected to ground to program timers that slave to an "up-stream" timer.

These pins can also be connected to ground through a double-pole switch to allow the timer to optionally be slaved to another timer or switched to allow local timing functions.

3.5.3 Offsetting the "slave" time display

If it is desired for the "slave" clock to display a different hour from the "master":

- a. Complete all wiring and set the proper time on the "master".
- b. Verify that the "master" and "slave" clock displays are identical.
- c. Place the "slave" into the set mode by holding the start and stop buttons until the clock lamp illuminates.
- d. Press and hold the "slave" stop button to advance the hours display.
- e. Press the "slave" start button to exit the set mode.

REMOTE CONTROL AND INSTALLATION OF OPTIONS

4

4.1 SERIAL WIRING

4.1.1 Wiring scheme

The RS485/RS422 is a balanced input requiring two connections between "master" transmitter and "slave" receiver. Twisted pair or shielded cable may be used. If shielded cable is used connect the shield only at one end. The cabling should be from the master to the farthest "slave", with drops taken from the cable to service "slaves" along the way. Dip termination switches #1 at the "master" and #2 at the furthest "slave" should be turned on.

4.1.2

Master slave clock wiring

Clocks and clock/timers only. When a unit with a clock display is connected as a "slave" and is receiving valid time information from another unit with a clock display or from a WWV receiver, the "slave" clock will display the information from the "master", and the "slave" sync lamp will illuminate. The hours displayed by the "slave" may be offset from the "master" transmitter if so desired. If serial data is interrupted, the sync lamp will extinguish and the clock will revert to local mode. If invalid data is received from a WWV receiver the sync lamp will blink and the clock will revert to local mode. This former "slave" now assumes the role as "master".

Timer functions and displays will function normally.

4.1.3

Master slave timer wiring

Timers and clock/timers only. When a unit with a timer display is wired as a "slave", and if pins 8 and 9 on the "slave" remote control are continuously held at ground, the "slave" timer will display timer information from the "master". If the "slave" also has a clock display, it will function independently from the "master" timer unless the "master" is a clock/timer or the "master" timer is receiving time information from a clock or WWV receiver.

Timer only units pass received time information directly from their receive input to their transmit output.

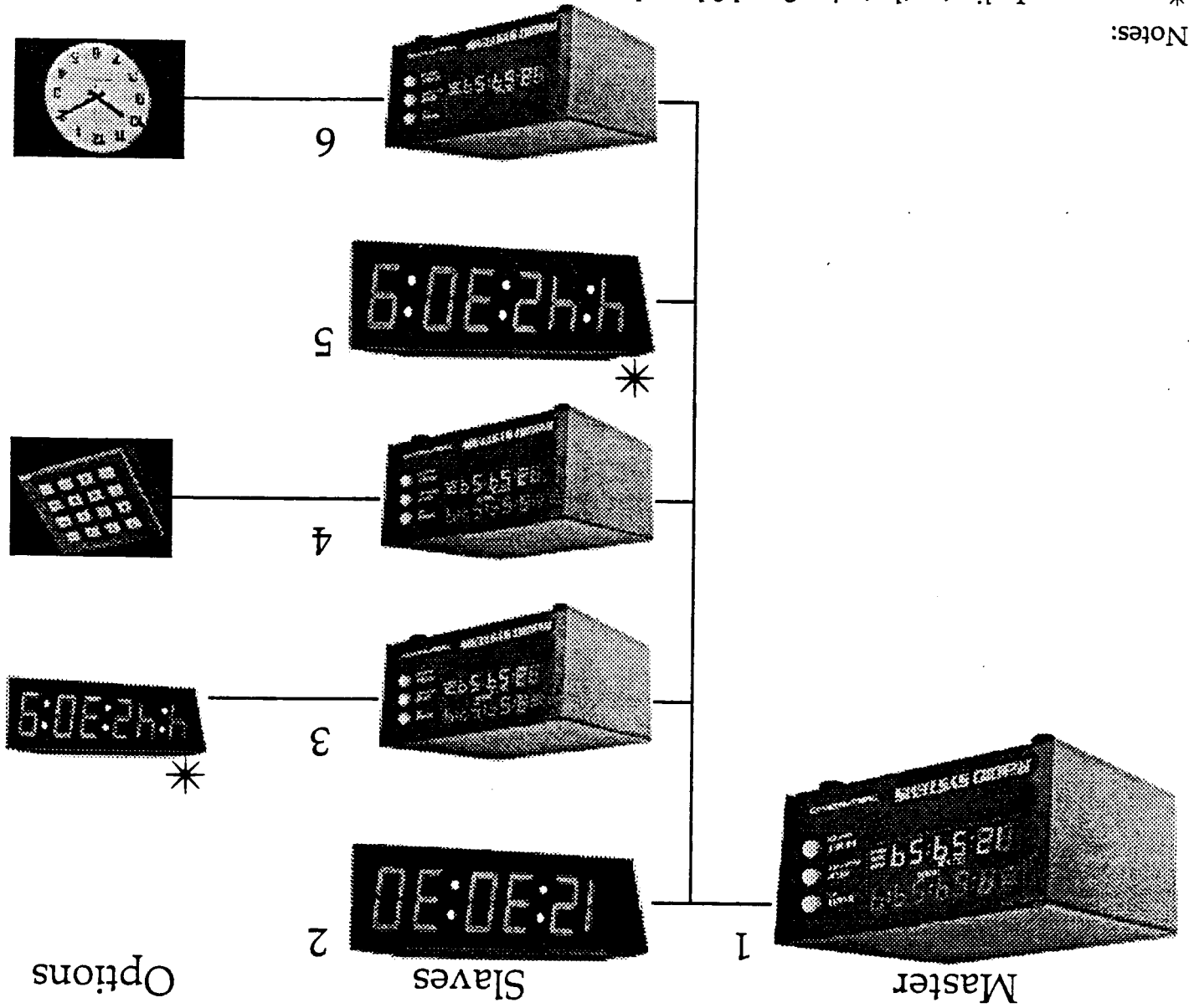
4.2

ANALOG CLOCKS

Radio Systems analog clocks may be wired directly to a unit with a clock display. Make the following connections:

Super Clock	10*	+DC
	11*	GND
	23*	SIG

Master Clock/Timer Mixed System Configurations



Notes:
*

Indicates that pins 8 and 9 have been connected to pin 11 (ground), saving the timer to the timer display preceding it in the serial chain. All clock displays will follow the master clock.

Unit 1 - Master clock/timer can be 2", or desk top. Serial transmit terminate (DIP switch 1) must be set on. Serial output lines connect to remote pins 1+ and 2-.

Units 2 to 5- Up to 32 2", or desk top units may be fed via the serial line. Serial input lines connect to remote pins 5+ and 4-.

Unit 4 - Any unit in the serial chain can be a timer or clock/timer and function as a down timer with the optional remote keypad if the remote pins are not strapped to set the unit as a slave timer.

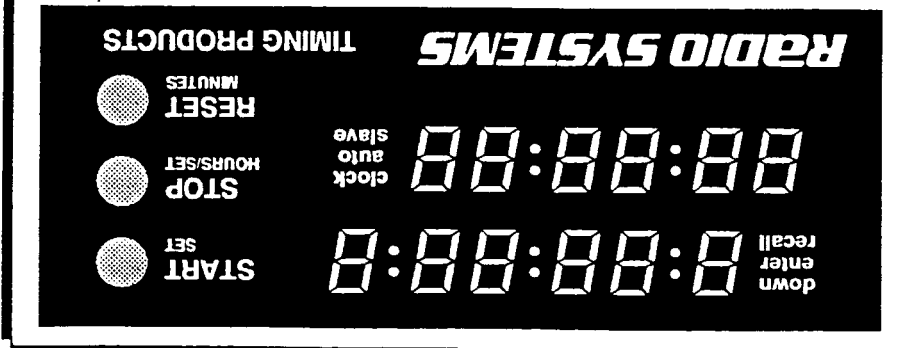
Unit 6 - Any unit in the serial chain can drive up to 6 analog clocks. Clocks are connected to remote pins 23 (10 Hz out), 10 (+5 V DC), and 6 (ground). The final unit in the serial chain must have its serial receive terminate (DIP switch 2) set on.

Illustration 4.1 - Clock/Timer System Configuration

"SUPER CLOCK" SYSTEM WIRING DIAGRAM

MASTER UNIT

USE ANY "SUPER CLOCK" MODEL



FOR 2" UNITS:
MODELS DWT-6
DWC-8

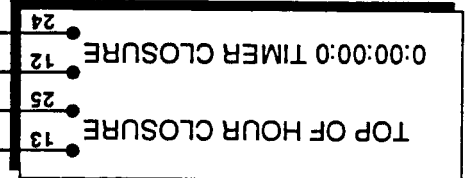
- ON OFF
- | | | | | | |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
1. XMIT TERMINATE
 2. RECV TERMINATE
 3. TIMER STOP AT 0
 4. 24 HOUR CLOCK
 5. NOT USED
 6. AC LINE SYNC
- NOTE: ON MASTER UNIT, SET 1 ON & 2 OFF; ON LAST SLAVE, SET 1 OFF & 2 ON; ON ALL OTHERS, SET 1 & 2 OFF.

FOR DESKTOP UNITS:

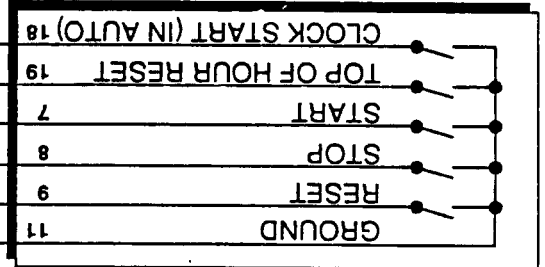
- ON OFF
- | | | | | | |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
1. XMIT TERMINATE
 2. RECV TERMINATE
 3. TIMER STOP AT 0
 4. 24 HOUR CLOCK
 5. NOT USED
 6. AC LINE SYNC
- NOTE: ON MASTER UNIT, SET 1 ON & 2 OFF; ON LAST SLAVE, SET 1 OFF & 2 ON; ON ALL OTHERS, SET 1 & 2 OFF.

NOTE: DO NOT USE THIS ILLUSTRATION FOR IN-CONSOLE CLOCKS. THE PIN OUTS ARE DIFFERENT.

RELAY CLOSURES*



REMOTE CONTROLS*

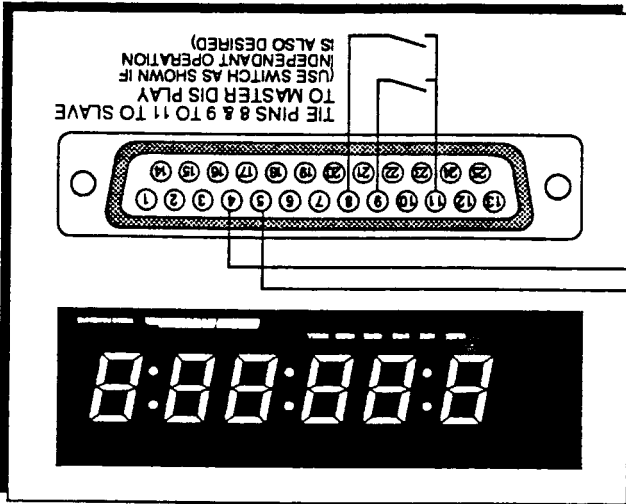


*NOTE: ALL OF THESE CONNECTIONS, WHEN APPLICABLE, CAN BE MADE TO ANY CLOCK OR TIMER IN THE SYSTEM.

RS-485 SERIAL LINK (NOTE: IF SHIELDED CABLE IS USED, CONNECT SHIELD TO GROUND ON ONE END ONLY)

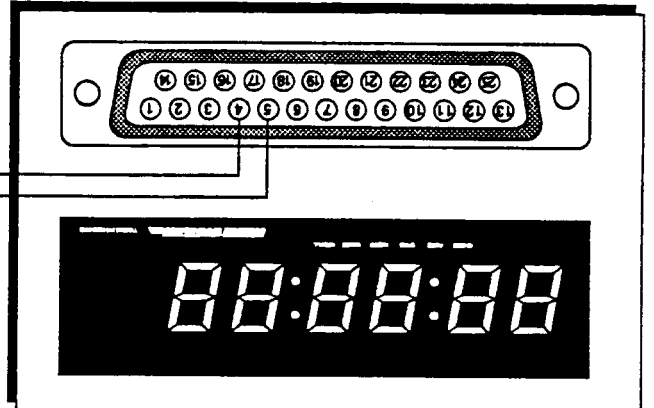
SLAVE TIMER

MODELS: DTC-6, DTT-6, DWT-6



SLAVE CLOCK

MODELS: DTC-6, DTC-6, DWC-6



TO UP TO 30 ADDITIONAL SLAVES CONNECTED IN PARALLEL

*NOTE - Do not use these terminals for in-console clocks, the pin-outs are different. Please refer to Illustration # 4.5.

4.3 RACK MOUNTING

4.3.1

Units with .53" displays

These units may be tabletop mounted or rack mounted with optional rack ears. They occupy 3.5" of vertical rack space. To install the rack ears, remove the screws that hold the cover to the side of the unit. Hold the rack ear in place and reinsert the screws by passing them through the rack ear and the cover.

4.3.2

Units with 2.25" displays

These units may be tabletop mounted or rack or wall mounted with optional rack ears. They occupy 5.25" of vertical rack space.

To install the rack ears, remove the screws that hold the cover to the side of the unit. Position the rack ear with the flange toward the front of the unit for rack mounting and towards the back for wall mount. Reinsert the screws by passing them through the rack ear and the cover.

4.4

DIP SWITCH SETTINGS

The dip switch can be set from the rear panel of the unit.

4.4.1

Transmit termination switch position 1

Turn this switch on if connections are made to the serial transmit output on the remote control.

4.4.2

Receive termination switch position 2

Turn this switch on if connections are made to the serial receive input on the remote control and if this unit is the furthest from the transmitter.

4.4.3

Down time stop at zero switch position 3

For timers and clock/timer only.

Turn this switch on to stop the down timing function when the display reaches 0:00:00.0 hour. Turn this switch off to allow down timing below zero. The unit will count negative one hour.

4.4.4

12/24 hour switch position 4

Clocks and clock/timers only.

Turn this switch on for 24 hour military time. Turn this switch off for 12 hour time.

4.4.5

Switch Position 5

Not used

Switch position 6 - clocks and clock/timers only

Turn this switch on to use the A.C. power line as a time base synchronization signal.

WIRING

4.5.1

Remote control wiring

NOTE - Do not use these pins for in-console clocks, the pin-outs are different. Please refer to Illustration # 4.5.

Pin#	Function
1	+ Transmit output: ("master" out) wire this to pin 5 of up to 32 "slave" units.
2	- Transmit output: ("master" out) wire this to pin 4 of up to 32 "slave" units.
3	Ground
4	- Receive input: ("slave" input) wire this pin to pin 2 of the "master" unit.
5	+ Receive input: ("slave" input) wire this pin to pin 1 of the "master" unit.
6	Ground
7	Start switch:
1.	timers - if not running, momentary contact to ground will start the timer.
2.	clocks - if in the clock set mode, momentary contact to ground will start the clock and exit the clock set mode. Holding this pin to ground simultaneously with pin 8 for four seconds will place the clock in the set time and auto start mode.
3.	clock/timer - if in the clock set mode, will function as described in #2 above. Otherwise will function as described in #1 above.
8.	Stop switch:
1.	timers - if running, momentary contact to ground will stop the timer. Holding this pin to ground simultaneously with pin 9 will place the timer in the "slave" timer mode.
2.	clocks - if in the clock set mode, momentary contact to ground will advance the hours display. Holding this pin to ground simultaneously with pin 7 for four seconds will place the clock in the set time and auto start mode.
3.	clock/timer - if in the clock set mode, will function as described in #2 above. Otherwise will function as described in #1 above.
9	Reset switch:
1.	timers - if up timing, momentary contact to ground will return the timer display to 0:00:00 and the unit will continue to up time. If the unit was previously up timing and is stopped prior to contacting the reset switch to ground, the unit will display 0:00:00 and hold. If previously down timing, momentary contact to ground will stop the down timer (if running) and return the display to the previous entered down time. A second momentary contact to ground will return the timer display to 0:00:00 and exit the down time mode. Holding this pin to ground simultaneously with pin 8 will place the timer in the "slave" timer mode.

2. clocks - if in the clock set mode, momentary contact to ground will advance the minutes display. This mode is not allowed in "slave" clock operation.
3. clock/timer - if in clock set mode, will function as described in #2 above otherwise will function as described in #1.
10. +5 volts D.C.
11. Ground
12. Relay momentary closure when down time equals 0:00:00:0. Timers and clock/timers only. See pin #24 for the other contact.
13. Relay momentary closure at the top of the hour. Clocks and clock/timers only. See pin #25 for the other contact.
14. Opto-isolated external synchronization input for the connection of a balanced, or alternating polarity signal. Clocks and clock/timers only. See section 3.4.1. The signal should be between 10 and 24 volts. When utilizing terminals 14 and 15 to opto-isolate a unipolar signal, terminal 14 is positive and terminal 15 is negative.
15. See terminal 14.
16. Unbalanced logic level external synchronization input. Clocks and clock/timers only. See section X3.4.1. A 1 Hz or 10 Hz positive going input signal should be between 3 and 24 volts when high.
17. Ground
18. Auto clock start - Clocks and clock timers only. If the clock is in the set mode and the auto lamp is illuminated (auto mode active) a momentary contact to ground will start the clock, and exit the clock set and clock auto modes.
19. Go to top of hour - Clocks and clock/timers only. If the clock display is within +10 minutes of the top of the hour, a momentary contact to ground will instantly reset the Clock display to the top of the closest hour.
20. Ground
21. Ground
22. 1Hz time base output - This output provides a continuous output (regardless of clock activity) from the selected time base and synchronization signal. See section 3.4. If the clock is in "slave" mode this signal is derived from serial data. This output is from an "HC" type gate and switches between 0 and 5 volts.
23. 10 Hz time base output - This output provides a continuous 10 Hz output (regardless of clock activity) from the selected time base and synchronization signal. See section 3.4. If the clock is in "slave" mode this signal is derived from the serial data, and outputs ten pulses immediately after reception of a new second. This output is from an "HC" type gate and switches between 0 and 5 volts.
24. See pin 12
25. See pin 13