

**DUKANE**



## Installation Manual

Models

**24A715,  
24A715M**

*Master Time/Program Clock*



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## NOTICE

To ensure the performance of our products and systems, we may occasionally make technological changes and updates. Therefore, the model number suffixes (A, B, C, etc.) listed in the manual or in the drawings may not always match the model you are using. Unless specifically noted, this will not affect the product or its installation, operation, or service.

## FCC COMPLIANCE STATEMENT

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

**WARNING:** Changes or modifications to this product not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

**NOTE:** This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio TV technician for help.

This Class B digital apparatus complies with Canadian ICES-003.

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## FOR UNITS EQUIPPED WITH AN INTERNAL MODEM (24A715M)

**NOTICE:** This equipment complies with Part 68 of the FCC Rules. On the mounting panel of this equipment is a label that contains, among other information, the FCC Registration Number and Ringer Equivalence Number (REN) for this equipment. If requested, provide this information to your Telephone Company.

The registration jack USOC for this equipment is (RJ-11). An FCC-compliant telephone cord and modular plug is provided with this equipment. This equipment is designed to connect to the telephone network or premises wiring using a compatible modular jack, which is Part 68 compliant. See installation instructions for details.

The REN is useful to determine the quantity of devices that may be connected to the telephone line. Excessive RENs on the telephone line may result in the devices not ringing in response to an incoming call. In most, but not all areas, the sum of REN of all devices should not exceed five (5). To be certain of the number of devices that may be connected to a line, as determined by the total REN, contact the local Telephone Company.

If your telephone equipment (Modem) causes harm to the telephone network, the Telephone Company will notify you in advance that temporary discontinuance of service may be required, but if advance notice isn't practical, you will be notified as soon as possible. You will be advised of your right to file a complaint with the FCC if you believe it is necessary.

Your Telephone Company may make changes in its facilities, equipment, operations, or procedures that could affect the operation of your equipment. If they do, you will be given advance notice so as to give you an opportunity to maintain uninterrupted service.

This equipment may not be used on public coin service provided by the Telephone Company. Connection to party lines is subject to state tariffs. (Contact your state public utility commission or corporation commission for information.)

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## SUPPLIER'S DECLARATION OF CONFORMITY

Place of Issue: St. Charles, IL

Date of Issue: August 17, 2001

Dukane Corporation, located at 2900 Dukane Drive, St. Charles, IL 60174 in the United States of America, hereby certifies that Master Clock model 24A715M bearing labeling identification number US:A95DT06B24A715M complies with the Federal Communications Commission's ("FCC") Rules and Regulations 47 CFR Part 68, and the Administrative Council on Terminal Attachments ("ACTA")—adopted technical criteria: TIA/EIA/IS-968, Telecommunications—Telephone Terminal Equipment—Technical Requirements for Connection of Terminal Equipment to the Telephone Network, July 2001.

*Rolf Goehler*

Rolf Goehler

General Manager, Communications Systems Division

**NOTICE:** The Industry Canada label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational and safety requirements. The Industry Canada does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local Telecommunications Company. This equipment must also be installed using an acceptable method of connection. In some cases, the company's inside wiring associated with a single line individual service may be extended by means of a certified connector assembly (telephone extension cord). The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

Any equipment repairs made by the user, or equipment malfunctions, may give the Telecommunications Company cause to request the user to disconnect the equipment.

Users should ensure, for their own protection, that the electrical ground connections of the power utility, telephone lines, and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

**CAUTION:** Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority or electrician, as appropriate.

**NOTE:** The Ringer Equivalence Number (REN) assigned to each terminal device provides an indication of the maximum number of terminals allowed to be connected to a telephone interface. The termination of an interface may consist of any combination of devices subject only to the requirement that the sum of the Ringer Equivalence Numbers of all the devices does not exceed five (5).

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## **A NOTE ABOUT THE LITHIUM BATTERY**

The Lithium Battery (coin cell) contained in this product is NOT user-replaceable. When replaced by an authorized Service Center, used batteries should be disposed of according to the manufacturer's instructions.

## CSD TECH WRITING DOCUMENT CORRECTION FORM

Operating, installing, or servicing a communications product is often difficult without well-written, accurate documentation. Please help us ensure you get the best performance from your Dukane product by completing this form if you encounter any problems, or if you have any suggestions for the manual.

Please provide the following optional information so we can contact you if we need more feedback.

Your Name \_\_\_\_\_

Company Name \_\_\_\_\_ Phone Number \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

**—IMPORTANT—**

**Please include the manual's document number found in the lower right corner of the front cover.**

\_\_\_\_\_

### Instructions

1. Please explain below how the manual should be changed, or describe the problems you encountered.
2. Use the back of this form for additional corrections or comments.
3. Mail or FAX this form (with a photocopy of the pages in question, if possible) to the address/FAX number on the back of the form. To mail, tri-fold this form so the address is visible.

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**Dukane Corporation**  
CSD Technical Writing  
2900 Dukane Drive  
St. Charles, IL 60174



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*Windows is a registered trademark of Microsoft Corporation.  
MasterLink is a trademark of Lathem Time Corporation.*

## General Information

This installation manual covers the Model 24A715 and 24A715M Master Clocks. Both clocks are installed and programmed in similar fashions. The main difference between the clocks is the 24A715M is equipped with a built-in modem capable of communicating with a PC, or for synchronizing with the NIST Atomic Clock. Both clocks have eight circuits that can be programmed to ring bells or activate circuits for up to 99 seconds, and/or synchronize the time on three types of clock systems (any two manufacturing brands of clocks listed in **Appendix B**, plus compatible RS-485 time synchronization devices). You can program up to 512 events to activate single or multiple circuits on a given day and time. The 24A715M can also connect to a PC running Microsoft Windows® using optional MasterLink™ software available from Lathem.

Unless otherwise specified, “master clock” refers to both units in this document.

The master clock can be programmed with these functions:

- User password
- Date and time
- Clock types to synchronize
- Manual bell control (example: sounding a fire alarm)
- Bell schedules (with events lasting up to 99 seconds)  
**Note:** If a contact closer in excess of 99 seconds is required, an external latching relay will be required. This relay is not supplied by Dukane.
- Dates when automatic schedule changes go into effect
- Manual circuit disabling (example: for safety during maintenance)
- Daylight saving time features
- Instant bell schedule changes
- Instant clock synchronization
- Holiday schedules
- Communications when using the master clock with an RS-485 network, modem access, or the optional MasterLink programming software (available from Lathem)

## Parts List

Verify that the master clock came with these parts:

- Master clock (ready to surface mount)
- User guide (document number 427-07-00047)
- Installation hardware kit with mounting screws and two extra cover screws
- Two L-brackets used for rack mounting
- Power supply box cover used for rack mounting

*continued*

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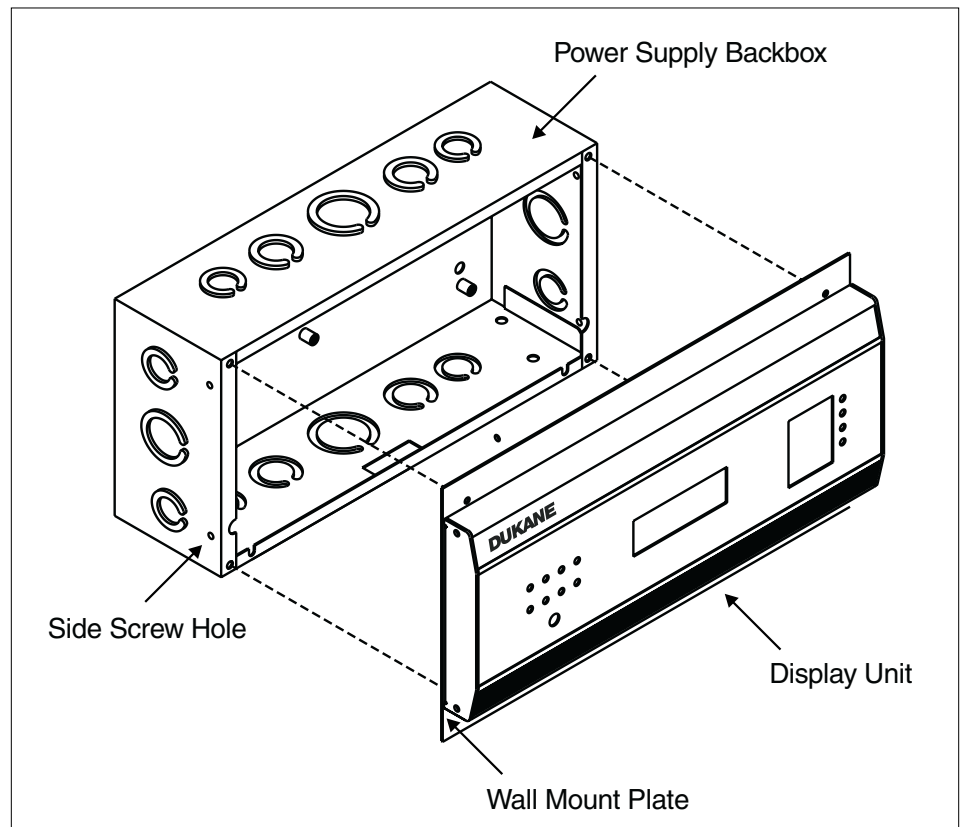
Optional equipment (*ordered separately from Lathem*):

- Connection cable if the power supply relay PCB is up to 8 feet (2.4 m) from the display unit
- Lathem MasterLink programming software to control the master clock from a PC
- Standalone modem
- Remote schedule selector switch

## Mounting the Master Clock

The master clock is shipped ready to surface mount on a wall. It can also be semi-flush mounted with the power supply recessed into the wall, or installed in a standard 19-inch (48.3 cm) rack. See **Figure 1-1** for wall mount assembly parts. The display unit can also be hung on the wall with the power supply hidden in the floor or ceiling; contact Lathem for details.

A qualified technician should install the master clock. The installation does not require any special tools, but may require extra hardware, wire, or other materials as required by local electrical codes.



*Figure 1-1*  
*Master Clock Wall-Mount Assembly Parts*



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## Surface Mounting

To surface mount the master clock:

1. Place the master clock on its back with the display unit facing up and the key pad to the right.
2. Remove the two screws at the top of the display unit mounting plate.
3. Lift the display unit up and away from the backbox. Two rivets at the bottom of the cover will prevent you from lifting it straight up.
4. Unplug the ribbon cable from the back of the display unit to disconnect it from the power supply.
6. Making sure they are level, place two anchors 10 inches (25.4 cm) apart on the wall where the clock is to be mounted. Use the appropriate anchors for the wall.
7. Screw two #8 screws into the wall anchors.
8. If needed, place two wall anchors 5 inches (12.7 cm) below the first two screws, to accommodate the other two mounting screws.
9. Hang the power supply onto the top two screws using the keyholes on the back.
10. Screw two more #8 screws through the two holes at the bottom of the power supply into the wall anchors.
11. Wire the clock. (See **Wiring the Master Clock** on page 1-8.)
12. Reconnect the ribbon cable.
13. Replace the display unit using the two screws removed in step 2.

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## Semi-Flush Mounting

The power supply portion of the master clock can be recessed into the wall, so that the display unit is semi-flush with the wall. This should only be done by a qualified technician.

To mount the master clock semi-flush:

1. Place the master clock on its back with the display unit facing up and the key pad to the right.
2. Remove the two screws at the top of the display unit mounting plate.
3. Lift the display unit up and away from the backbox. Two rivets at the bottom of the cover will prevent you from lifting it straight up.
4. Unplug the ribbon cable from the back of the display unit to disconnect the power supply.
5. Set the display unit aside.
6. Prepare the clock's position in the wall:

The power supply backbox measures 12 inches (30.5 cm) wide by 6 inches (15.2 cm) high by 3-3/8 inches (8.6 cm) deep.

The wall mount cover measures 13 inches (33 cm) wide by 7 inches (17.8 cm) high by 1-1/4 inch (3.2 cm) deep, and extends 1/2 inch (1.8 cm) around the backbox.

Cut a 12-1/4 inch (31.1 cm) by 6-1/4 inch (15.9 cm) hole in the wall between two studs where you want to hang the master clock.

7. Cut two blocks of wood for filler and attach them to the studs.
8. Screw the power supply box to the blocks using the two holes on each side of the box.
9. Wire the clock. (See **Wiring the Master Clock** on page 1-8.)
10. Reconnect the ribbon cable.
11. Replace the display unit using the two screws removed in step 2.

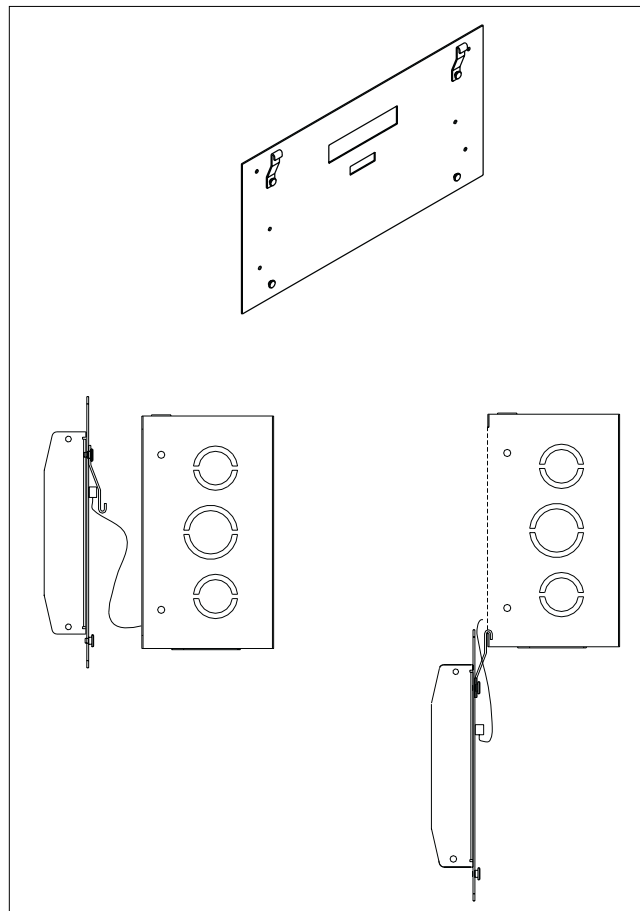
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## Using the Installer's Hooks to Hang the Display Below the Backbox

When mounting the clock in either semi-flush or surface installations, the hooks on the back of the display unit mounting plate can be used to hang the display unit below the backbox to allow access for circuit testing and programming. See **Figure 1-2**.

To use the hooks:

1. Remove the two screws securing the display unit to the backbox.
2. Lift the unit up and away from the backbox, leaving the ribbon cable attached. Two rivets at the bottom of the cover will prevent you from lifting it straight up.
3. If you have a semi-flush installation, remove the green communications connector plug from the back of the display unit. This allows the unit to sit flat against the wall.
4. Swing up the two hooks on the back of the unit and hook them over the bottom edge of the backbox. You now have access to the key pad for making program changes or manually activating the circuits, and access to the relay and connector blocks inside the backbox.



*Figure 1-2*  
*Hook Mounting the Display Unit*

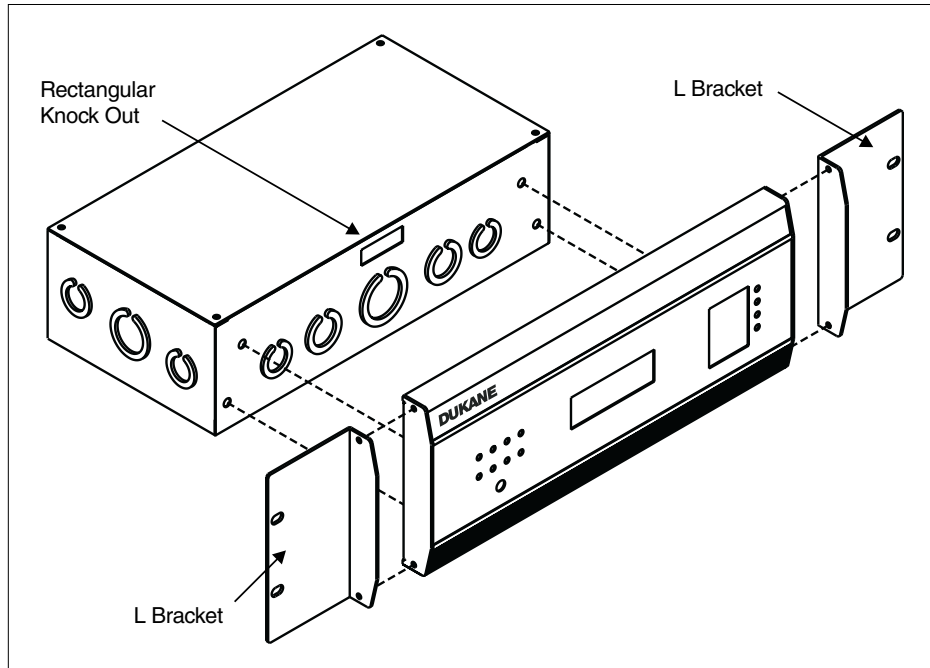
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## Rack Mounting

The two L-shaped brackets and the box cover supplied with the master clock can be used to install it in a standard 19-inch (48.3 cm) rack. See **Figure 1-3** on page 1-7.

To rack mount the clock:

1. Place the master clock on its back with the display unit facing up and the key pad to the right.
2. Remove the two screws securing the display unit to the backbox.
3. Lift the display unit up and away from the backbox. Two rivets at the bottom of the cover will prevent you from lifting it straight up.
4. Unplug the ribbon cable from the back of the display unit to disconnect the power supply.
5. Detach the display unit from the wall mount plate by removing the four screws on the back of the display unit. (IMPORTANT: Do not lose these screws. They are a specific length so they do not interfere with the circuit board inside the display unit. Using any other screws to attach the display unit to the case will void any warranty.)
6. Remove the rectangular knock out near the top of the power supply. See **Figure 1-3** on page 1-7.
7. Using the four screws removed in step 5, attach the display unit to the bottom of the power supply. To assist you, there are holes opposite the four screw holes where you can fit a #1 Philips screwdriver with an 8-inch (20.3 cm) blade.
8. Reconnect the ribbon cable from the power supply to the display unit.
9. Remove the two screws from one side of the display unit, then use them to attach an L bracket to the side of the unit. See **Figure 1-3** on page 1-7. Repeat to attach the other bracket to the other side.
10. Mount the unit in the rack.
11. Wire the clock before attaching the box cover. See **Wiring the Master Clock** on page 1-8.
12. Attach the cover to the power supply using four 6-32 screws. Two of these screws were removed from the display unit in step 2. The other two were supplied with the clock.



*Figure 1-3  
L Brackets for Rack Mounting*

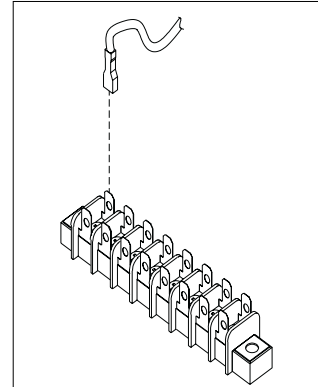
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## Wiring the Master Clock

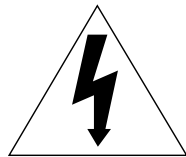
This section provides instructions on wiring the power source, secondary clocks, and signaling devices to the master clock. It does not cover the connection of the optional modem, a computer, any RS-485 devices, and a power source for the optional remove schedule selector. Instructions for those devices are provided in **Appendix C**.

Stranded wire is recommended for use inside the power supply box, as it allows a firm connection to the quick connect terminals. There is also less chance of stranded wires interfering with the components on the relay board. If solid wire must be used, join the stranded wire to the solid wire in another box.

The master clock is supplied with quick connects. These should be attached to the wires as necessary so that the wiring can be connected to the terminal blocks as shown in **Figure 1-4**.



*Figure 1-4  
Plugging Quick Connects  
into the Terminal Block*



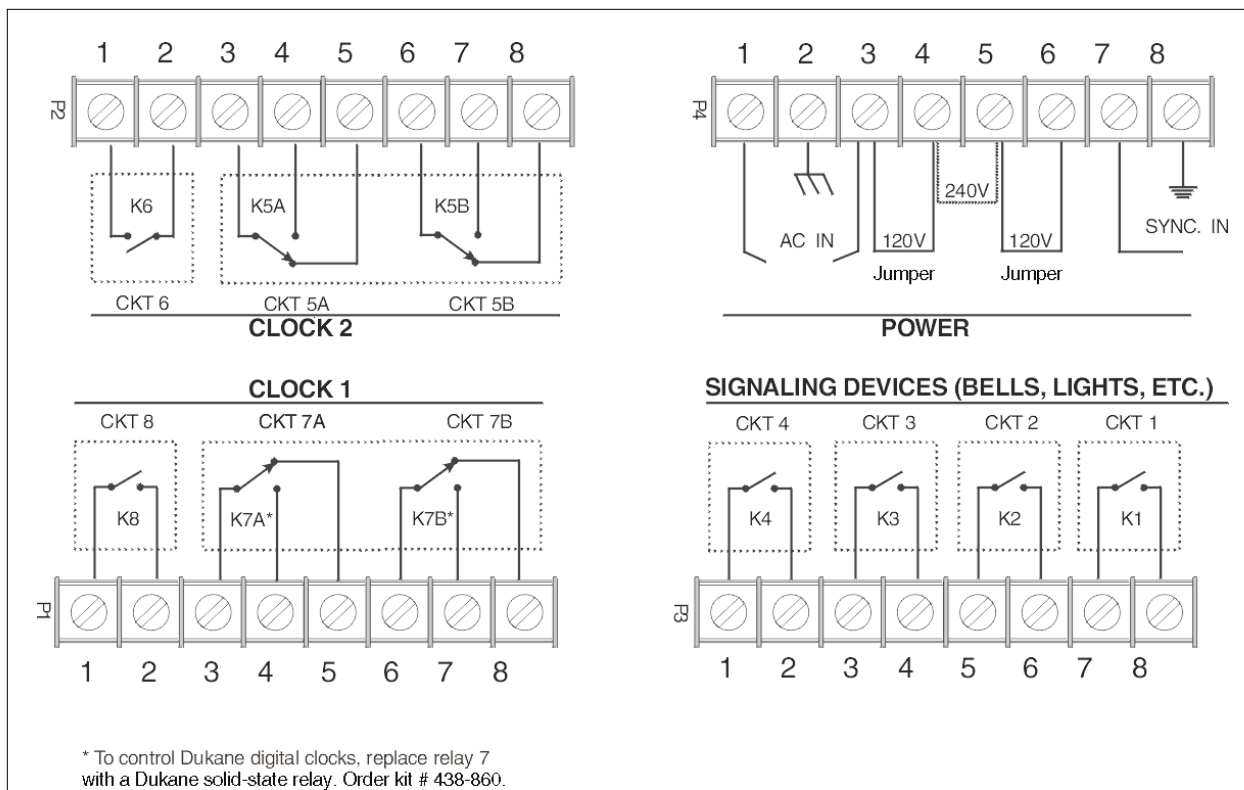
**—WARNING—**  
Failure to properly connect the ground wire  
can increase interference and cause  
unsafe operating conditions.

## Wiring Procedure

**Figure 1-5** on page 1-9 shows terminal blocks P1 through P4, located on the PCB in the power supply backbox. Follow the steps below the figure to wire the clocks, power source, and signaling devices to the master clock.

### Notes:

- Circuits CKT1 through CKT4 designate bell controls. Circuit pairs CKT5/CKT6 and CKT7/CKT8 can function as clock synchronization circuits or as bell controls.
- MOVs (Metal-Oxide Varistors) protect all relay contacts.
- Voltage-select jumpers connect to terminal block P4 for 120Vac operation. For clocks that must run at 220/240Vac, remove the 120V jumpers and install one jumper wire for the 240V selection. The system will automatically adjust for operation at 50Hz or 60Hz at either voltage. Also see **Terminal Block P4** on page C-2.
- Some clock setups may require external diodes or MOVs. See the wiring diagram for your type clock (see **Appendix B**).



*Figure 1-5  
Master Clock Terminal Blocks*

1. Wire the power source to P4 as shown in either **Figure C-1** or **C-2** on page C-2.

**Note:**

The master clock is shipped set up for 120Vac operation. To wire it for 220/240Vac, change the jumper settings as shown in **Figure C-2**.

**—WARNING—**

**DO NOT turn on AC power, and keep the power/relay unit's toggle switch OFF until you complete the rest of the wiring in this section.**

**—WARNING—**

**Applying 220/240Vac power to a system not set up for that voltage level can severely damage the electronic parts.**

- 
2. Wire the secondary clocks to P1 and/or to P2. See **Wiring Secondary Clocks** on page B-2 for complete instructions.

**Note:**

You may need to add external metal-oxide varistors (MOVs) or diodes to synchronize a specific clock type. See the clock wiring diagrams in **Appendix B**.

3. Wire the signaling devices to P3. See **Typical Signal Device Wiring** on page C-3.

**Note:**

If the master clock is not connected to any secondary clocks, signaling devices can be wired to P1 and P2.

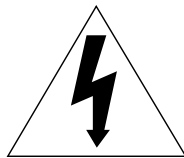
4. Although the master clock is fused internally to protect its electronics, the incoming AC line must also be fused as required by your local electrical code. Dukane recommends connecting the unit to a dedicated 10-amp circuit.

5. Turn the toggle switch in the power supply to the ON position.

6. Complete any mounting steps in the previous section, **Mounting the Master Clock** on page 1-2.

## Synchronizing Non-Compatible Clocks by External Pulse

The master clock can synchronize to other systems if necessary. For example, you have a non-compatible time clock that cannot be synchronized by the master clock, but it has a built-in bell ringer. By shorting terminals 7 and 8 on terminal block P4, or terminals 6 and 7 of the communications terminal on the back of the display unit, the master clock will immediately reset to 00:00 (midnight). If you can program the other device to close its circuit at 00:00 (midnight) then the two systems will remain reasonably in sync.



**—WARNING—**

**DO NOT** apply power to the external pulse-sync terminals. Simply close the circuit for 1–5 seconds.



## Setting Up the Master Clock

Once the master clock is installed, it is ready for programming. This chapter covers the programming instructions needed to set the master clock for operations.

**Note:**

To completely clear the clock of all settings and reset the master clock to its factory-shipped configuration, press the following number sequence on the master clock key pad: **355379768274**. This clears all programmed schedules and reinitializes the master clock.

### Programming Relays

If the master clock will control one type of secondary clock, relays #7 and #8 on terminal block P1 are used for this purpose. If the master clock will control a second clock type, relays #5 and #6 on terminal block P2 are used for those clocks. See **Table 2-1**.

Bell Zone #1	Bell Zone #2	Bell Zone #3	Bell Zone #4	Bell Zone #5	Bell Zone #6	Bell Zone #7	Bell Zone #8
Relay #1	Relay #2	Relay #3	Relay #4	Relay #5	Relay #6	Relay #7	Relay #8
				Clock Sync #2		Clock Sync #1	

*Table 2-1  
Relay Usage*

Here are some possible ways to program the master clock relays:

- Eight bell zones that can last from 1 to 99 seconds. Use this setup if the master clock will *not* be used to synchronize secondary clocks. (**Note:** The maximum closure time provided by this master clock is 99 seconds. Closures longer than 99 seconds will require an external latching relay. This is not provided by Dukane.)
- Six bell zones and one wall clock synchronization control. Use this setup if the master clock will only synchronize one type of clock in one string.
- Four bell zones and two wall clock synchronization controls. Use this setup if the master clock will synchronize two clock types, or if there are two strings of clocks (typically 20 to 35 clocks to a string).

---

## Programming Functions

This section explains how to put the master clock in program mode and configure the necessary functions to get the master clock running. For definitions of all functions, key pad commands, and the bell test, see **Section 3—Function List**.

The master clock is normally in clock mode, displaying the date and time. To access program mode, press [#] on the key pad. Pressing [\*] stops programming so you can re-enter a setting or quit.

### Entering the Password

The administrative password provides access to both advanced functions and user functions. The user password only provides access to user functions.

The factory-programmed user password is **000000**, and can be changed (see page 3-6). User passwords are explained further in the Master Clock User Guide, document 427-07-00047.

The factory-programmed administrative password is **332537**, or DEALER (as spelled out on a telephone key pad). It cannot be changed.

**Note:**

To keep the administrative functions secure, only give this guide to authorized personnel.

The following shows the key sequence to enter the password, and the resulting clock display:

<b>Administrative Password:</b>		<b>User Password:</b>	
Press	Display	Press	Display
[#]	SELECT FUNCTION CODE	[#]	SELECT FUNCTION CODE
[0]	[0] = ENTER PASSWORD	[0]	[0] = ENTER PASSWORD
[#]	PASSWORD: 000000	[#]	PASSWORD: 000000
[3][3][2][5][3][7]	PASSWORD: 332537	[user password]	PASSWORD: NNNNNN
[#]	ADMINISTRATOR	[#]	PASSWORD ACCEPTED
	PASSWORD ACCEPTED		

The display returns to clock mode (the time and date) after a few seconds.

**Notes:**

A password expires after approximately five minutes. If the master clock starts blocking access to programming functions, re-enter the password.

To manually expire a password, see **Securing the Setup** on page 2-9.

---

## Setting the Date and Time

Use the [1]=SET DATE / TIME function to set the date and time.

Enter the user password as shown on page 2-2, then follow the key sequences below:

Press	Display
[#]	SELECT FUNCTION CODE
[1]	[1]=SET DATE / TIME
[#]	ENT. DATE: MM-DD-YYYY
[0]...[8]	Enter the numbers for the month, date, and year (four-digit year)
[#]	ENTER DAY-OF-WEEK: D 1=SUNDAY...7=SATURDAY
[1]...[7]	Enter a number [1]–[7] for the day of the week, Sunday through Saturday TODAY IS (selected day)
[#]	ENTER TIME: HH:MM
[0]...[8]	Enter the time of the next upcoming minute, using either 12-hour of 24-hour format. If using 24-hour format, enter midnight as 00:00.
[#]	SELECT [0]PM / [1]AM You will only see this if you enter a time less than 13:00 (1:00 PM).
[0] or [1]	PRESS [#] IF CORRECT
[#]	Clock returns to time display.

---

## Enabling the Relays

Use the [6]=ENABLE CIRCUITS function to enable or disable the master clock's control relays during circuit wiring or maintenance. This function can also hold back clocks to manually adjust for daylight saving time in the fall if the daylight saving function is not in use (see **Setting Daylight Saving Time** on page 2-7). The ENABLE CIRCUITS function only enables the relays; it does not turn them on. See **Manually Activating Bell Controls** on page 2-6 to turn on the relays.

Enter the administrative password as shown on page 2-2, then follow the key sequences below:

Press	Display
[#]	SELECT FUNCTION CODE
[6]	[6]=ENABLE CIRCUITS
[#]	SELECT ACTIVE BELL ZONES 12345678 CLOCK CKTS PRESS [#] IF CORRECT
[1]...[8]	Enter the circuit numbers that you want to enable or disable by toggling the numbers; when you see all the circuits you want enabled on the display, press [#].
[#]	PRESS [#] TO CONFIRM

---

## Choosing the Clock Types to Synchronize

To select a clock type for the master clock to synchronize, use the [2]=SELECT CLOCK CTL function. This allows you to match the master clock to the type of secondary clocks installed. This function configures both clock #1 (relays 7 and 8) and clock #2 (relays 5 and 6), if present.

**Notes:**

To check the current master clock configuration, use the quick command [\*] while the clock is in clock mode. The CLK1 and CLK2 clock type code numbers appear in the fourth line of the display. (See **Appendix B** for a list of the clock codes.)

If the master clock will synchronize Dukane digital clocks, verify that relay 7 has been replaced with the solid-state relays available in the Dukane kit #438-860. Then assign code 07 to CLK1.

Enter the administrative password as shown on page 2-2, then follow the key sequences below:

Press	Display
[#]	SELECT FUNCTION CODE
[2]	[2]=SELECT CLOCK CTL
[#]	ENABLE CLOCK CIRCUIT SELECT CLK1 CODE: NN [#] FOR CODE LIST Refer to <b>Appendix B</b> , or press [#] repeatedly to scroll the code list.
[0]...[9]	Enter the two-digit code for CLK1, then press [#]. If you will not use a CLK1, enter 00.
[#]	CLK TYPE CODE: NN If you chose a CLK1 type other than 00, you will see: SELECT CLK2 CODE: NN
[0]...[9]	Enter the code for CLK2, or 00 if you will not use a CLK2.
[#]	PRESS [#] IF CORRECT
[#]	Press [#] to accept, or [*] to cancel and try again.

---

## Manually Activating Bell Controls

Use the [3]=MANUAL BELL CTRL function to test the bell circuits.

This function does not require a password. Follow the key sequences below:

Press	Display
[#]	SELECT FUNCTION CODE
[3]	[3]=MANUAL BELL CTRL
[#]	MANUAL BELL CONTROLS 1-2-3-4-5-6-7-8 PRESS AND HOLD [#] TO EXECUTE. [*] TO END
[1]...[8]	Enter the circuit numbers to be tested, then press and hold [#]. Those circuits will turn on their relays, as shown by the green panel lights, and the bells connected to the activated circuits will sound. When you release the [#], the circuits will turn off their relays. Either choose and test other circuits, or press [*] to quit. <b>Note:</b> Only circuits configured as bell zones will appear. Circuits 5–8 will not appear if the master clock has been programmed to use these relays for control of secondary clocks.
[*]	Return to time and date display (clock mode).

---

## Testing the Bells

Use the AUTO BELL TEST function to turn on all bell relays once per minute at the start of each minute. This tests the continuity of the bell wiring circuits. This function does not require a password.

1. If you have entered a password within the last several minutes, deactivate it by following the instructions under **Securing the Setup** on page 2-9. If you do not, you will toggle the clock between 12- and 24-hour format during this procedure.
2. Use the [6]=ENABLE CIRCUITS function to disable any relays that you do not want to include in the test (see **Enabling the Relays** on page 2-4).
3. While the clock is displaying the time, press [2][3][5][5][8][7][8] to start the bell test. While entering this code, ignore anything that displays on the screen.  
**Note:**  
After you enter the test command, there may be a delay before the bells sound.
4. When done, re-enter [2][3][5][5][8][7][8] to stop the test.
5. Use the [6]=ENABLE CIRCUITS function to re-enable any relays disabled in step 2.

## Setting Daylight Saving Time

If your region observes daylight saving time, use the [7]=DAYLIGHT SAVINGS function to enter the country code so the master clock will automatically adjust for daylight saving time. The factory-programmed country code is 08 (United States). See **Appendix A** for a list of country codes.

### Notes:

If your nation does not appear in the country code list, or if the dates for daylight saving in your country have changed, choose code 00 and use the optional Lathem MasterLink software to program clock adjustments. If your region does not observe daylight saving time, choose code 00.

Enter the administrative password as shown on page 2-2, then follow these key sequences:

Press	Display
[#]	SELECT FUNCTION CODE
[7]	[7]=DAYLIGHT SAVINGS
[#]	ENTER COUNTRY CODE FOR DAYLIGHT SAVINGS TIME ADJUSTMENT: 08 (default)
[0]...[9]	Enter the country code (see <b>Appendix A</b> ).
[#]	Press [#] to accept or [*] to cancel.

---

## Setting Communications

The [B]=COMMUNICATIONS function is used to enter data transmission speed and a terminal ID number. Use this function if the clock will be programmed to call the NIST atomic clock, or if you are using the optional Lathem MasterLink software to program the master clock. The clock can be set up using RS-232 (serial), RS-485 (networked), or modem (remote) communications. You must enter the same settings for the Model 24A715M in the programming software.

You can view the current terminal ID# and baud rate by using the quick command [\*] when the master clock is in clock mode.

Enter the administrative password as shown on page 2-2, then follow the key sequences below:

Press	Display
[#]	SELECT FUNCTION CODE
[9]	[9]=SYNCH. CLOCKS
[0][0]	[B]=COMMUNICATIONS
[#]	COMMUNICATIONS SETUP SELECT BAUD RATE: [2]400 -OR- [9]600
[2] or [9]	Press [2] for 2,400 baud or [9] for 9,600 baud (9,600 is the default) <b>Note:</b> If the clock will be programmed to call the NIST atomic clock, you must select 9,600 baud.
	9600 (or 2400) BAUD SELECTED ENTER TERM ID# NNN
[0]...[9]	Enter a unique terminal ID# from 00–127 (065 is the default)
[#]	PRESS [#] TO CONFIRM
[#]	Press [#] to accept or [*] to cancel and try again.



---

## Securing the Setup

At this point you have finished the basic setup of the master clock and it should be up and running. The clock can now be programmed with user-specific settings such as bell schedules and holidays. For detailed information, see the Master Clock User Guide, document 427-07-00047.

The master clock automatically exits from program mode if you stop using the key pad for five minutes. To exit programming mode immediately and prevent others from accessing the master clock, simply enter an invalid password. For example:

Press	Display
[#]	SELECT FUNCTION CODE
[0]	[0]=ENTER PASSWORD
[#]	PASSWORD: 000000
[9][9][#]	INVALID PASSWORD
[*]	Returns clock to time display.

## *Notes*

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## Introduction

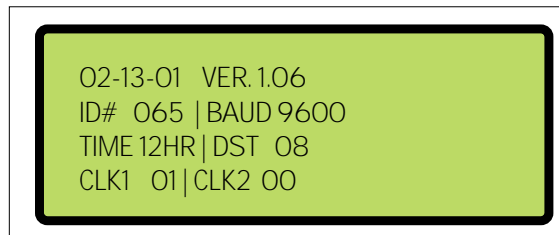
This chapter lists all functions accessible through the master clock key pad. For detailed instructions on these functions, see **Section 2—Configuration** and the Master Clock User Guide, document 427-07-00047.

## Quick Commands

Quick commands are used to display system information for about two seconds. You can press the quick keys, [\*], [1], or [3], when the master is displaying the time and date.

### (\*) READ STATUS

Any time the master clock is in clock mode (displaying time and date), press [\*] to see the master clock status. See **Figure 3-1** and **Table 3-1**.



*Figure 3-1  
Status Display*

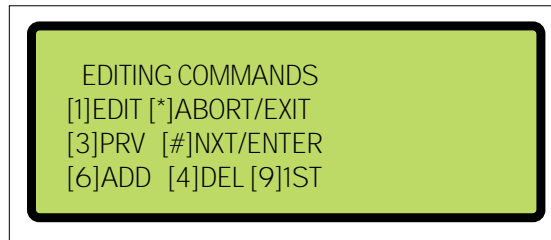
Display	Description
Date	Displays current programmed date
ID# xxx	Terminal ID#
TIME	Shows if display is in 12- or 24-hour format
CLK1   CLK2	Clock types this master clock will synchronize
VER. x.xx	Firmware version
BAUD	Baud rate for network communications
DST	Daylight saving time country code

*Table 3-1  
READ STATUS Definitions*

---

### (1) VIEW EDIT KEYS

Any time the master clock is in clock mode (displaying time and date), press [1] to see the edit key designations. See **Figure 3-2** and **Table 3-2**. The edit keys are used when programming bell schedules, automatic schedule change dates, and holiday dates. Quick command [1] only displays a listing of the edit keys for reference; you cannot make a selection from this display.



*Figure 3-2*  
*Edit Keys Display*

<b>Display</b>	<b>Description</b>
[1] EDIT	Edit the displayed record
[3] PRV	Show the previous record
[6] ADD	Add a new record
[*] ABORT/EXIT	End and exit
[#] NXT/ENTER	Show the next record
[4] DEL	Delete the displayed record
[9] 1ST	Show the first record (in ascending order)

*Table 3-2*  
*List of Edit Keys*

### (3) 12/24 HOUR TOGGLE

Any time the master clock is in clock mode (displaying time and date), enter the user password, then press [3] to toggle the time between 12-hour and 24-hour format. The upper right corner displays AM or PM for 12-hour format, or the day of the week for 24-hour format (for example, WE for Wednesday or HO for Holiday).

---

## Programming Commands

To access the master clock's programming functions, press [#] to enter program mode. When SELECT FUNCTION CODE appears on the display, the clock is ready for programming. The master clock will automatically exit out of program mode if you have not made a key pad entry for five minutes.

### (0)=PASSWORD

A password is required for most programming functions. To enter either the administrative or user password, press [#][0][#], followed by the six-digit password, then press [#].

You can now program the master clock until the password expires. A password expires after approximately five minutes. If the master clock starts blocking access to programming functions, re-enter the password.

The administrative password **332537** [DEALER] enables you to access both user and advanced functions.

The default user password **000000** is used to access user functions. Use the [C]=CHANGE PASSWORD function to change your user password (see page 3-6). You cannot change the administrative password.

### (1)=SET DATE / TIME

To set the date and time, see **Setting the Date and Time** on page 2-3.

### (2)=SELECT CLOCK CTL

This function requires the administrative password. Use this function to choose the clock types that the master clock will synchronize.

See **Choosing the Clock Types to Synchronize** on page 2-5.

---

### **(3)=MANUAL BELL CTRL**

This function does not require a password. Use this function to test bell circuits or to manually ring a bell at an unscheduled time.

See **Manually Activating Bell Controls** on page 2-6.

### **(4)=PROGRAM SCHEDULE**

Use this function to set bell schedules. Bell schedules are defined as the days and times when the bell circuits will turn on.

Enter the password, then press [#][4][#]. See the Master Clock User Guide, document 427-07-00047, for complete instructions.

### **(5)=SCHEDULE CHANGES**

Use this function to activate schedules on a specific start date and time. Use this function if you wish to activate schedules at future dates. You can program up to 16 changes at a time.

Enter the password, then press [#][5][#]. See the Master Clock User Guide, document 427-07-00047, for complete instructions.

### **(6)=ENABLE CIRCUITS**

This function requires the administrative password. Use this function to enable and disable bell relays during circuit wiring or maintenance. This function can also hold back clocks to manually adjust for daylight saving time in the fall if you do not use the [7]=DAYLIGHT SAVINGS function.

**Note:**

Disabled relays will ignore any schedules, and you cannot manually turn them on.

See **Enabling the Relays** on page 2-4.

---

## **(7)=DAYLIGHT SAVINGS**

This function requires the administrative password. Programming the master clock with the appropriate two-digit country code enables it to automatically adjust for daylight saving time.

See **Appendix A** for the country code list, and see **Setting Daylight Saving Time** on page 2-7.

## **(8)=CHANGE SCHEDULES**

Use this function to override any active bell schedules that were set up using the [5]=SCHEDULE CHANGES function, or to immediately run a schedule set up using the [4]=PROGRAM SCHEDULE function.

Enter the password, then press [#][8][#]. See the Master Clock User Guide, document 427-07-00047, for complete instructions.

## **(9)=SYNCH. CLOCKS**

Use this function to immediately synchronize any secondary clocks. This function is primarily used during initial installation, or if power to the secondary clocks is interrupted.

Enter the password, then press [#][9][#]. See the Master Clock User Guide, document 427-07-00047, for complete instructions.

## **(A)=PROGRAM HOLIDAYS**

The master clock can be programmed with up to 16 holidays. During holidays, only the events that are set to occur on holidays will turn on when they reach the scheduled time.

Enter the password, then press [#][9][0][#]. See the Master Clock User Guide, document 427-07-00047, for complete instructions.

---

## **(B)=COMMUNICATIONS**

This function requires the administrative password. Use this function to set the master clock's terminal ID# and baud rate.

See **Setting Communications** on page 2-8.

## **(C)=CHANGE PASSWORD**

Use this function to change the default user password (000000) to another six-digit number to prevent unauthorized access to the master clock's programming functions. Keep a copy of this password in a safe place.

Enter the current user password, then press [#][9][0][0][0][#]. See the Master Clock User Guide, document 427-07-00047, for complete instructions.

## **AUTO BELL TEST**

No password is required for this function. Use the AUTO BELL TEST function to turn on all bell relays once per minute at the start of each minute when you need to test the continuity of the bell wiring circuits.

See **Testing the Bells** on page 2-7.



# Appendix A

## Daylight Saving Country Codes

DAYLIGHT SAVING COUNTRY CODES					
ALBANIA	02	ENGLAND	01	MALTA	02
ANDORRA	02	ESTONIA	02	MONACO	02
ARMENIA	02	FALKLAND ISLANDS	10	NETHERLANDS	02
AUSTRIA	02	FINLAND	02	NEW ZEALAND	11
AZERBAIJAN	02	FRANCE	02	NORWAY	02
AZORES	02	GERMANY	02	POLAND	02
BAHAMAS	08	GIBRALTER	02	PORTUGAL	02
BALEARIC ISLANDS	02	GREECE	02	ROMANIA	02
BELARUS	02	GREENLAND	07	RUSSIA	02
BELGIUM	02	HAITI	07	SAN MARINO	02
BERMUDA	08	HUNGARY	02	SCOTLAND	02
BOSNIA/HERZEGOVINA	02	IRAN	02	SLOVAKIA	02
BRAZIL	13	IRAQ	03	SLOVENIA	02
BULGARIA	02	IRELAND	02	SPAIN	02
CANADA	08	ISRAEL	04	SWEDEN	02
CHANNEL ISLANDS	01	ITALY	02	SWITZERLAND	02
CHILE	12	JAMAICA	08	SYRIA	03
CROATIA	02	JORDAN	05	TURKEY	02
CUBA	06	KAZAKHSTAN	02	UKRAINE	02
CYPRUS	02	KYRGYZSTAN	02	UNITED KINGDOM	02
CZECH REP	02	LATVIA	02	UNITED STATES	08
DENMARK	02	LEBANON	02	VATICAN CITY	02
EASTER ISLAND	02	LIECHTENSTEIN	02	YUGOSLAVIA FED.	02
EGYPT	09	LUXEMBURG	02	USER-SPEC. DATES	00

*continued*

<b>DAYLIGHT SAVING TIME CODES AND DURATION</b>			
Code	Start and end date	Code	Start and end date
01	Last Sunday in March, 3rd Sunday in October	08	First Sunday in April, last Sunday in October
02	Last Sunday in March, last Sunday in September	09	First day of May, last day of September
03	First day of April, last day of September	10	Second Sunday in September, 2nd Sunday in March
04	First Friday in April, 1st Sunday in September	11	First Sunday in October, 3rd Sunday in March
05	First Friday in April, 3rd Friday in September	12	Second Sunday in October, 2nd Saturday in February
06	First Sunday in April, 1st Saturday in October	13	Third Sunday in October, 2nd Sunday in February
07	First Sunday in April, last Sunday in October		

# Appendix B

## Secondary Clock Types

SECONDARY CLOCK TYPE CODES			
Type	Description	Type	Description
01	Synchronous Wired	06	Faraday
01	Lathem Type SS	06	Honeywell ST402A
01	Cincinnati D10	07	Dukane 24F200 Digital (Obsolete)
01	Dukane 24SS Series	07	Dukane 24F750, 24F750A (Obsolete)
01	IBM 77 Series	07	Dukane 24D20, 24D20A, 24D40
01	Simplex 77 Series	08	Rauland 2410 Digital
01	Simplex 93-9	09	Simplex Dual Motor/59
01	Simplex 91-9	10	Simplex Dual Motor/45
01	Simplex 941-9	11	Edwards Dual Motor
01	Simplex 943-9	12	Cincinnati D6
01	Standard Electric D10, D12	13	Two-Wire Pulse Alternating
01	Stromberg 3000	14	Electronic Coded
02	Three-Wire Minute Impulse/59	15	Straight Frequency
02	Lathem ISC Two- and Three-Wire	16	Impulse with 12-Hour Correction/59
02	Cincinnati D2-D4	17	Standard Electric Time AR2/3
02	Dukane 24ISC Series	18	National Synchronous Wired
02	Edwards Impulse	18	Dukane 240 Series (Obsolete)
02	Faraday Impulse	18	Rauland 2463 Series (Analog)
02	IBM 75 Series	19	Stromberg Synchronous Wired/56
02	Simplex 75 Series	19	Lathem SS Modified
02	Simplex 91-4	20	Three-Wire Minute Impulse/44
02	Simplex 93-4	21	Cincinnati D1
02	Simplex 941-4	22	Dukane Synchronous Wired
02	Simplex 943-4	23	Condor 2412 Digital
02	Standard Impulse	23	Rauland 2422 Digital
02	Stromberg Impulse	24	Edwards Synchronous Wired Clocks, Type E1
03	Standard Electric Synchronous	27	Simplex 2310 Dual Motor
04	Standard Electric Time AR-2A	28	Stromberg 12-Hour
05	Three-Wire Minute Impulse/58	29	Type 01 Special
06	Synchronous Wired	30	Type 14 Special
06	Cincinnati D8		

**Note:**

Types 25 and 26 are used by manufacturer for internal testing only.

---

## Wiring Secondary Clocks

The next several pages contain wiring diagrams and theory of operation for the secondary clocks. These are listed in numerical order according to type code number.

**Note:**

All circuits should be fused or protected by a circuit breaker (10A maximum).

The 24A715 and 24A715M master clocks are factory-equipped to operate analog clocks on the CLK1 output (relays 7 and 8), and CLK2 output (relays 5 and 6).

**—IMPORTANT—**

**If the master clock will operate Dukane digital clocks, the digital clocks MUST be operated from the CLK1 output (relays 7 and 8), and relay 7 MUST be replaced with a solid-state relay to support the digital clocks. To obtain the required solid-state relay, order Model 438-860 from Dukane.**

### TYPE 01—Synchronous Wired

For a list of Type 01 clocks, see the chart on the first page of this appendix.

In normal operation, the synchronous secondary clocks are operated from 24Vac or 120Vac, using the 60Hz power source to maintain clock accuracy. An error in the time displayed by the secondary clock can be introduced by a power failure. The master clock will correct the time displayed on the secondary clock using two synchronization methods: minute hand correction and absolute correction.

Minute hand correction takes place once every hour, even if there is no error in the displayed time. The master clock sends an eight-second pulse to the secondary clock's correction circuit, starting at the 57th minute and 54th second, and lasting until the 58th minute and 2nd second of every hour. This causes the secondary clock to advance its hands until the minute hand is correct. The hour hand will still be in error at the end of this cycle if the error at the beginning of the cycle was in excess of one hour.

If the secondary clocks are more than one hour off, the master clock initiates an absolute correction by sending a six-second pulse, beginning at 5:58:02 (both AM and PM) and ending at 5:58:08. This correction cycle takes a long time to completely update the secondary clocks. Depending on how far off the secondary clocks are, the correction cycle can take many hours to complete. The correction cycle does not run continuously, so it may be difficult to establish whether or not the secondary clocks have completed their correction activities.

Please note that the relay contacts used in the CLK2 circuit are rated at 10 amps. The combined load of the correction circuit and the run circuit should not exceed 8 amps. In general, 20–35 analog clocks can be operated on a single string. This number depends on the clock style and the distances involved. To estimate clock loads for Dukane 24SS series clocks, see the Dukane Analog Clock Installation Guide (document number 402-455).

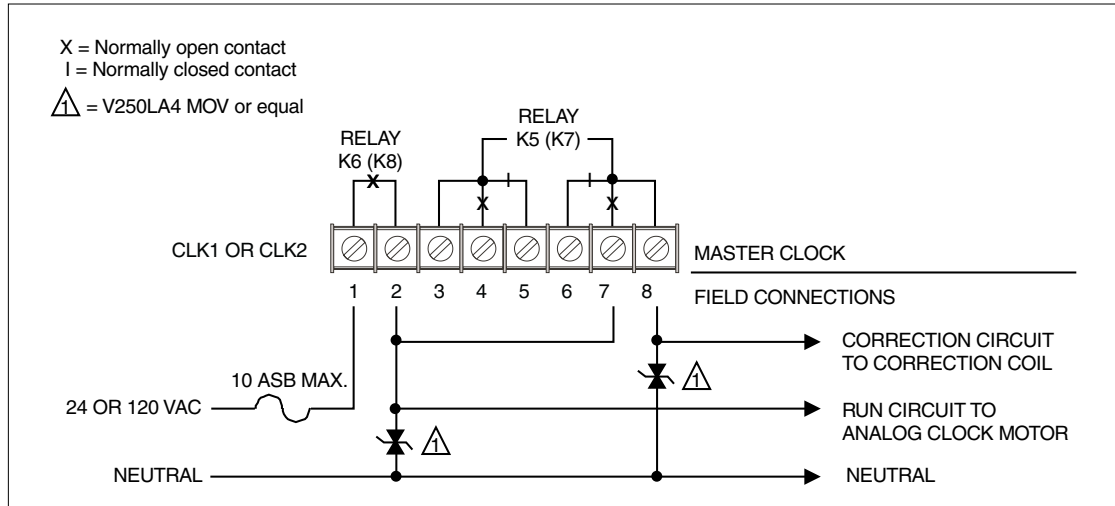


Figure B-1  
 Three-Wire Synchronous (59th Minute, Dukane 24SS)

## TYPE 02—Three-Wire Minute Impulse (59th Minute)

There are two types of Type 02 secondary clocks: the three-wire minute impulse covered on this page, and the two-wire reverse polarity minute impulse on the following page.

**Note:**

For a list of Type 02 clocks, see the chart on the first page of this appendix.

From the 58th second to 00 seconds each minute, a 24Vdc pulse is transmitted to the secondary clocks. From the 59th minute through the 49th minute, the pulse is transmitted on both the A and B lines. From the 50th minute to the 59th minute, the pulse is transmitted on the A line only.

Clocks that reach the 59th minute ahead of the master clock stop, since at this time they respond only to the pulses transmitted on the B line. During the 59th minute, from 10 seconds through the 50th second, 20 rapid pulses are transmitted at 0.5Hz on the A line to advance all slow clocks.

An accumulator, designed in the software, counts the number of minutes lost due to power failure. Upon resumption of power, the master clock transmits pulses on lines A and B to immediately advance the slow clocks to the proper time. Resetting the time after a power failure terminates these correction signals.

Manual clock advances and daylight saving advances cause the master clock to transmit 62 pulses (1 second ON and 1 second OFF at 0.5Hz). The first five pulses are transmitted on lines A and B. The remainder of the pulses are transmitted on line A only. Normal minute pulses are inhibited during these pulses.

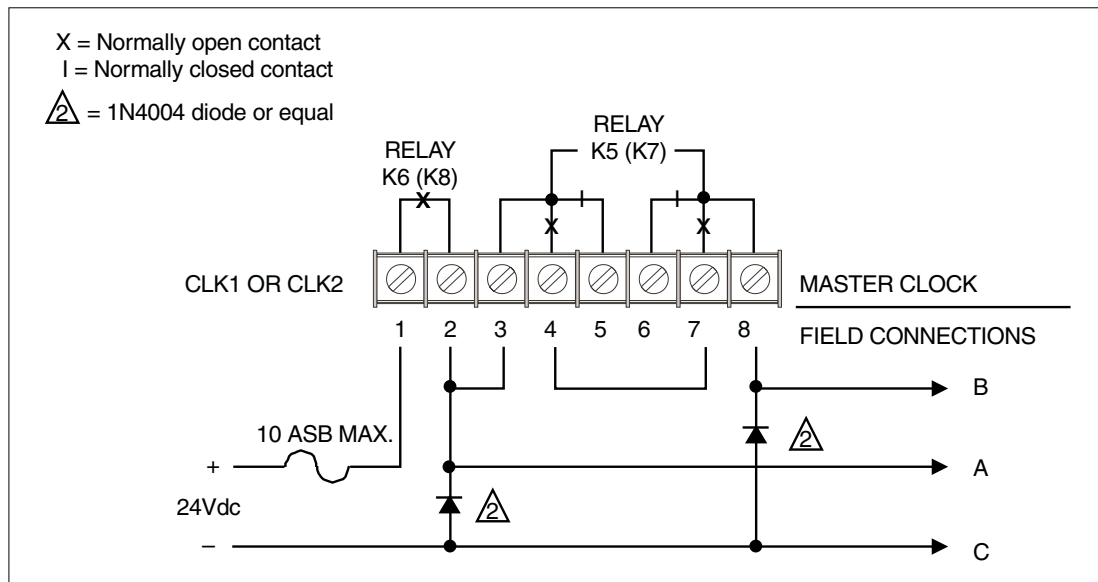


Figure B-2  
Three-Wire Minute Impulse (59th Minute)

## TYPE 02—Two-Wire Reverse Polarity Minute Impulse (59th Minute)

There are two kinds of Type 02 secondary clocks: the two-wire reverse polarity minute impulse covered on this page, and the three-wire minute impulse on the previous page.

**Note:**

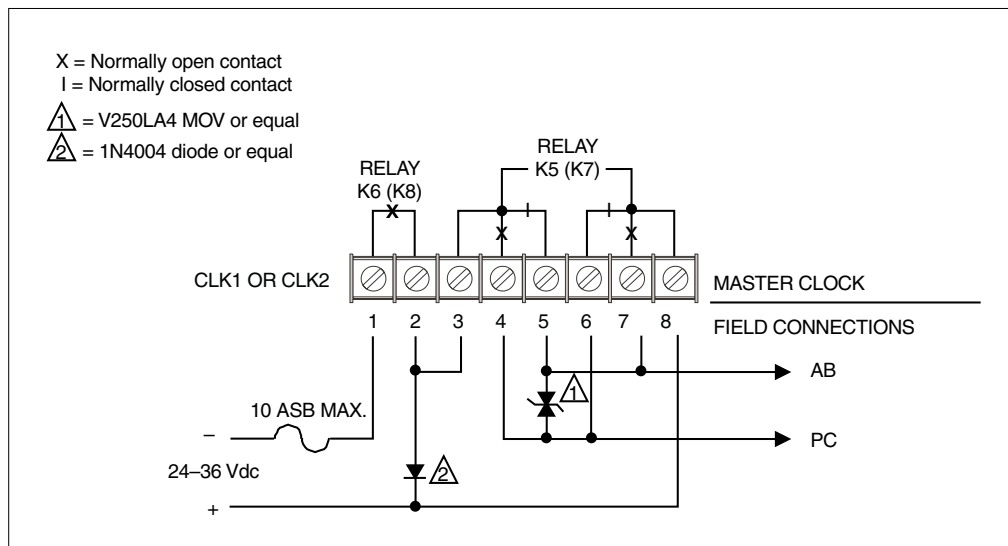
For a list of Type 02 clocks, see the chart on the first page of this appendix.

Every minute, from the 58th second to 00 seconds, a 24Vdc pulse is transmitted to the secondary clocks. From the 59th minute through the 49th minute, the pulse is transmitted with line AB positive with respect to PC. From the 50th minute to the 59th minute, the pulse is transmitted with line AB negative with respect to PC. Clocks that reach the 59th minute ahead of the master clock stop, since at this time they respond only to pulses transmitted with line AB positive with respect to PC.

During the 59th minute, from 10 seconds through the 50th second, 20 rapid pulses are transmitted at 0.5Hz to advance all slow clocks. During the rapid pulsing, line AB is negative with respect to PC. Connect a diode as shown in **Figure B-3** for arc suppression of the relay contacts.

An accumulator, designed in the software, counts the number of minutes lost due to power failure. When power is restored, the master clock transmits pulses with line AB positive with respect to PC to immediately advance the slow clocks to the proper time. Resetting the time after a power failure terminates these correction signals.

Manual clock advances and daylight saving advances cause the master clock to transmit 62 pulses (1 second ON and 1 second OFF at 0.5Hz). The first five pulses are transmitted with line AB positive with respect to line PC. The remainder of the pulses are transmitted with line AB negative with respect to line PC. Normal minute pulses are inhibited during these pulses.



*Figure B-3*  
 Two-Wire Reverse Polarity Minute Impulse (59th Minute)

## TYPE 03—Standard Electric Synchronous

During normal operation, 120Vac is applied to the run motor. A 15-minute correction signal on the correction motor line causes a 12-hour correction from 5:12:00 to 5:28:00. This occurs twice daily (AM and PM). Run motor power is connected during the 12-hour correction. A 29-second signal is applied to the correction motor line from HH:59:30 to HH:59:59 to cause hourly corrections. During hourly corrections, power is disconnected from the run motor line.

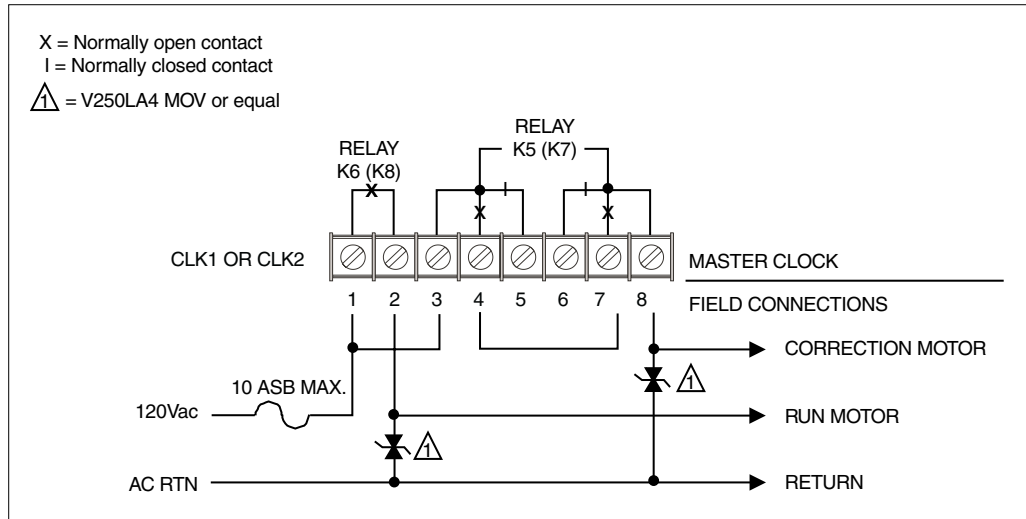


Figure B-4  
 Standard Electric Synchronous



## TYPE 04—Standard Electric Time AR-2A Two-Wire, Dual Voltage

Each minute, from 58 seconds to 00 seconds, a low-voltage pulse (24Vdc) is transmitted. The secondary clocks receive the pulses until the 59th minute. At this time, from 50 seconds to 00 seconds, a higher voltage pulse (48Vdc) is required to advance to the hour.

Manual clock advances and daylight saving advances cause the master clock to transmit 62 pulses (one second ON and one second OFF at 0.5Hz), all at 24Vdc. Normal minute pulses are inhibited during these pulses.

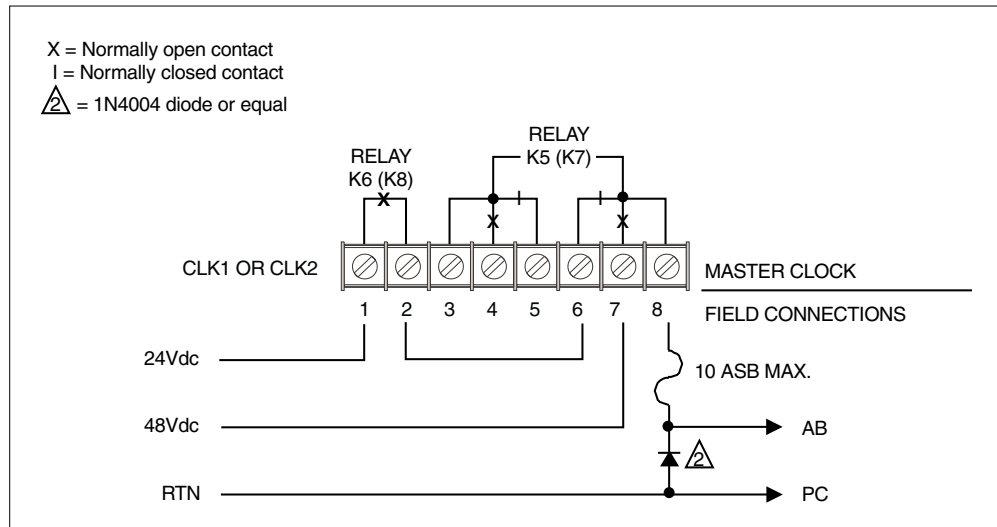


Figure B-5  
Standard Electric Time AR-2A Two-Wired, Dual Voltage

## TYPE 05—Three-Wire Minute Impulse (58th Minute)

Each minute, from the 58th second to 00 seconds, a 24Vdc pulse is transmitted to the secondary clocks. From the 58th minute through the 48th minute, the pulse is transmitted on both the A and B lines. From the 49th minute to the 58th minute, the pulse is transmitted on the A line only. Clocks that reach the 58th minute ahead of the master clock stop, since at this time they respond only to pulses transmitted on the B line. During the 58th minute, from 10 seconds through the 50th second, 20 rapid pulses are transmitted at 0.5Hz on the A line to advance all slow clocks.

An accumulator in the master clock software counts the number of minutes lost during a power interruption. When power is restored, the master clock transmits pulses on both lines A and B to immediately advance the slow clocks to the correct time. Resetting the time after a power interruption terminates these correction signals.

Manual clock advances and daylight saving advances cause the master clock to transmit 62 pulses (one second ON and one second OFF at 0.5Hz). The first five pulses are transmitted on lines A and B. The remainder of the pulses are transmitted on line A only. Normal minute pulses are inhibited during these pulses.

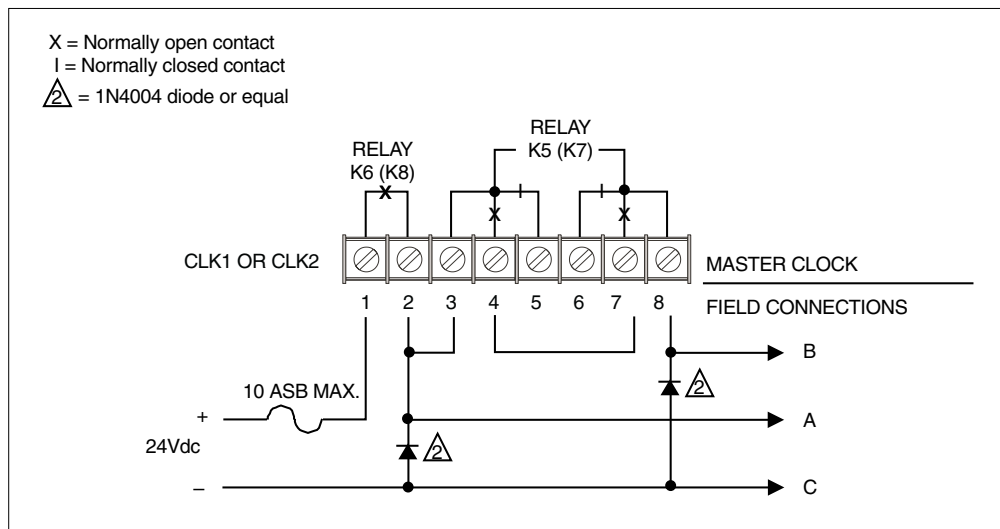


Figure B-6  
Three-Wire Minute Impulse (58th Minute)

## TYPE 06—Synchronous Wired

For a list of Type 06 clocks, see the chart on the first page of this appendix.

The clock run motor receives 120Vac continuously, with 120Vac furnished to the clock correction coil for 55 seconds each hour from HH:58:05 to HH:59:00 to cause hourly corrections. Ten 120Vac signals are furnished to the clock correction coil (each for 95 seconds) beginning at 5:05:00, 5:07:00, 5:09:00, 5:11:00, 5:13:00, 5:15:00, 5:17:00, 5:19:00, 5:21:00 and 5:23:00 to cause the 12-hour correction. The final 12-hour signal ends at 5:24:35 (before the 5:30 lockout).

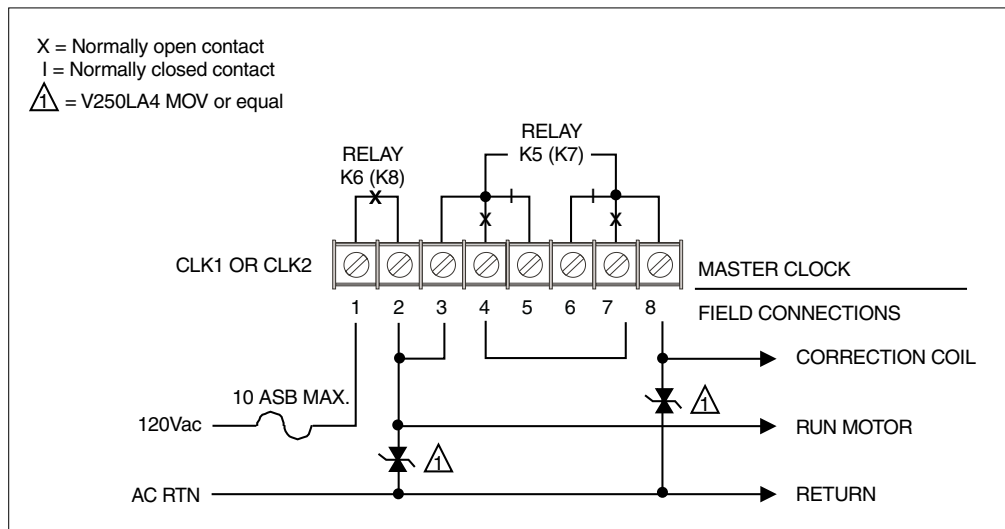


Figure B-7  
Synchronous Wired

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## TYPE 07—Dukane Digital Clocks

For a list of Type 07 clocks, see the chart on the first page of this appendix.



**—IMPORTANT—**

**Dukane digital clocks MUST be connected to CLK1 (relays 7 and 8) on the master clock. Also, for the master clock to operate Dukane Digital clocks, its factory-installed relay K7 MUST be replaced with a solid-state relay, part number 596-303, available from Dukane in the Model 438-860 kit.**

**Notes:**

Dukane Model 24D20 and 24D40 are only used with 15Vdc power when being added to existing installations. In new installations, these two models should be used with 24Vac power.

See the 24D20 and 24D40 installation manuals (document numbers 427-11-00035 and 427-11-00036) for instructions on establishing the current capacity for the 24Vac power supply.

During normal operation the clock signal is grounded once every minute at zero seconds (HH:MM:00) to increment the time display. Once every 24 hours the master clock synchronizes all clocks to 12:00:00 AM.

The master clock automatically synchronizes the clocks after a power failure or when the master time is reset. During synchronization the clocks reset, then after 40 seconds the master clock slowly advances the clocks to the correct time. The clocks can be manually reset using the [9]=SYNCH. CLOCKS function (see page 3-5), or by momentarily interrupting the AC power to the master clock.

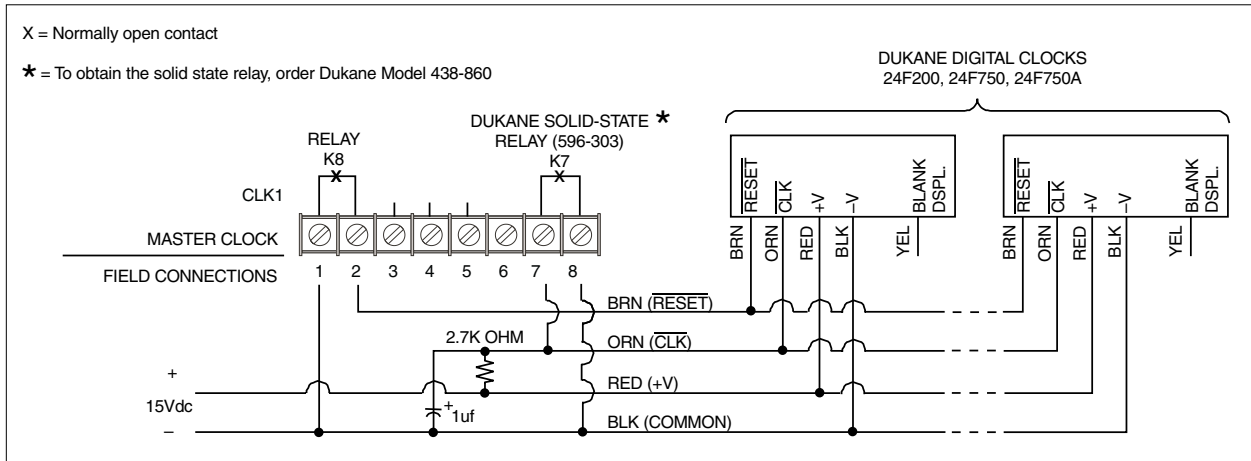


Figure B-8  
 Wiring Dukane 24F200, 24F750, and 24F750A Digital Clocks for 15Vdc

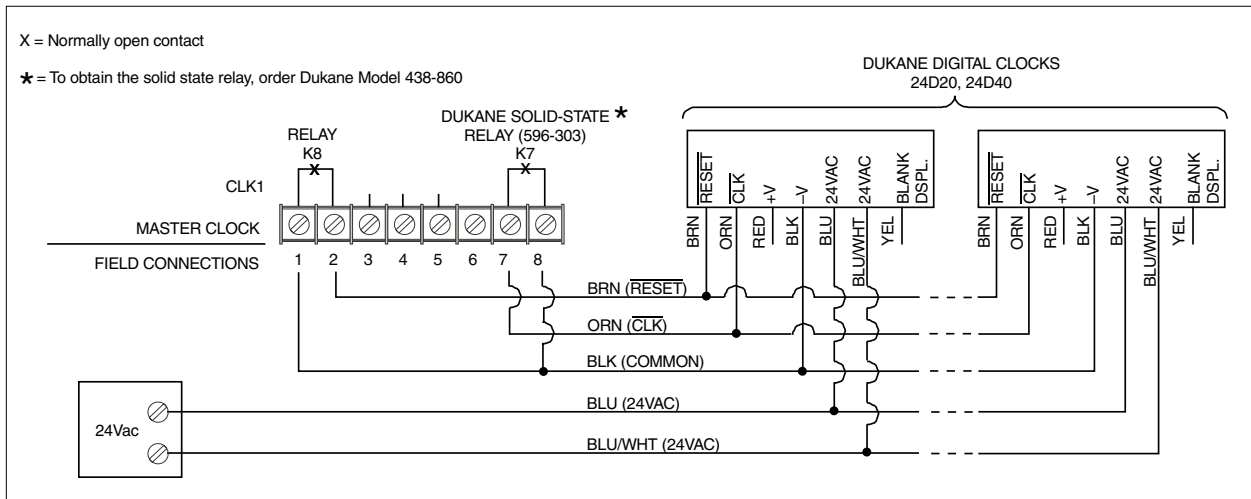


Figure B-9  
 Wiring Dukane 24D20 and 24D40 Digital Clocks for 24Vac

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## TYPE 08—Rauland 2410 Digital Clocks (24Vac and 120Vac)

Rauland 24Vac or 120Vac digital clocks initialize to 12:01 AM when first powered up. During normal operation, the clocks maintain time by counting the 60Hz AC line frequency. When the line voltage drops below 120Vac, the digital clocks start rapidly advancing at two minutes per second. After applying power to the master clock and entering system selection code 08, the master initializes to 12:01 AM and applies normal voltage to the digital clocks, causing them to set to 12:01 AM.

After initial power-up, any time change made at the master clock causes the SYS LED to illuminate, indicating that the digital clocks are about to be corrected. At the 56th second, the master clock removes power from the digital clocks, then at the 59th second applies low voltage to the clocks, causing them to rapidly advance to the new time.

When the new time is reached, the master clock reapplies the normal voltage. If the digital clocks become unsynchronized with the master, they can be manually reset using the [9]=SYNCH. CLOCKS function. See page 3-5.

When a manual clock advance is initiated, the SYS LED illuminates, power is removed at the 56th second, and a low voltage is applied at the 59th second, causing the clocks to advance to the current master time, at which point normal voltage is reapplied.

When a daylight saving mode, either forward or back, is initiated at 2:00 AM Sunday, the master removes power from the clocks and applies low voltage, causing the clocks to rapidly advance to the new time, either 1:00 AM or 3:00 AM, at which point normal voltage is reapplied.

Every 24 hours at 12:00:56 AM, the master clock removes power from the clocks, then reapplies power at 12:00:59 AM, causing the clocks to set to 12:01:00 AM, thereby synchronizing the clocks with the master clock.

See **Figures B-10** and **B-11** on the next page for the 120Vac and 24Vac wiring.

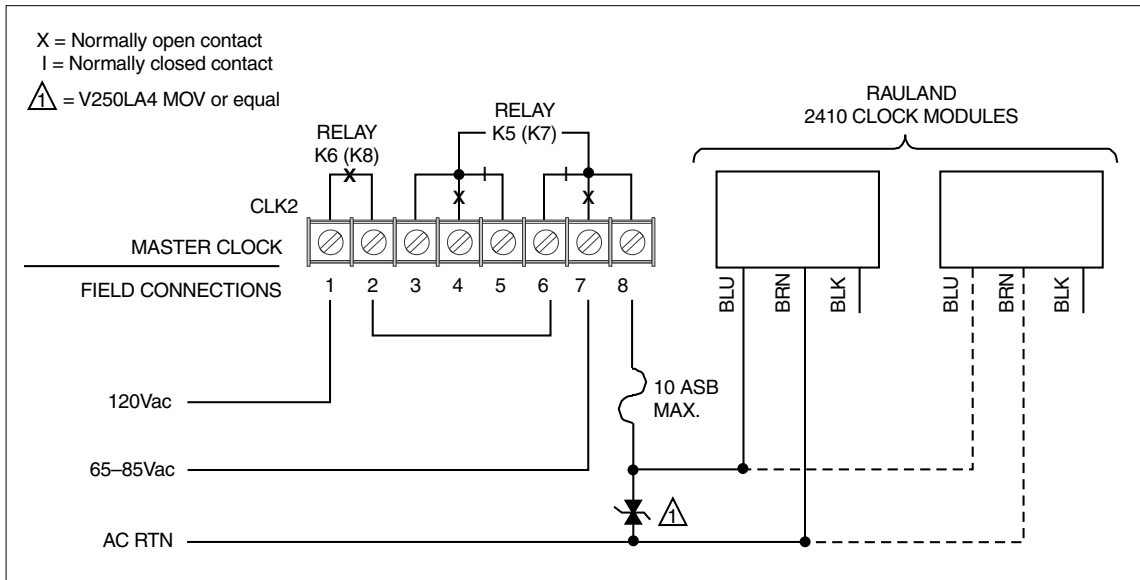


Figure B-10  
 Wiring Rauland 2410 Digital Clocks for 120Vac

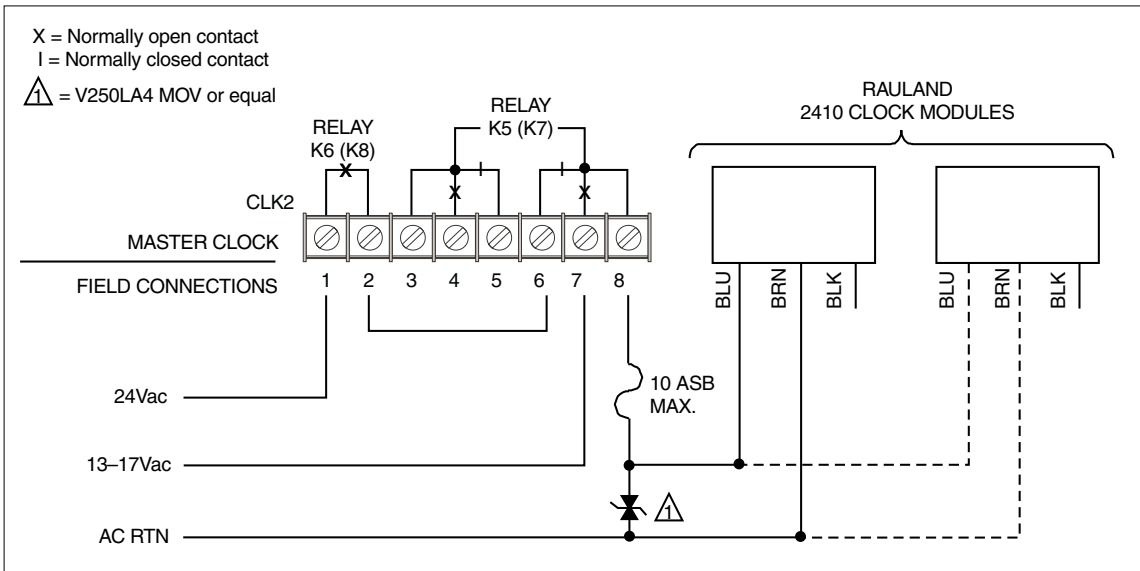


Figure B-11  
 Wiring Rauland 2410 Digital Clocks for 24Vac

## TYPE 09—Simplex 59th Minute, Dual Motor

Power is normally applied to the 1 RPM run motor. Each hour, from HH:58:05 through HH:58:59, power is removed from the run motor and applied to the fast advance motor. During manual clock corrections, power is applied to both motors for 4 minutes and 15 seconds. See **Figure B-12**.

## TYPE 10—Simplex 45th Minute, Dual Motor

Power is normally applied to the 1 RPM run motor. Each hour, from HH:44:05 through HH:44:59, power is removed from the run motor and applied to the fast advance motor. During manual clock corrections, power is applied to both motors for 4 minutes and 15 seconds. See **Figure B-12**.

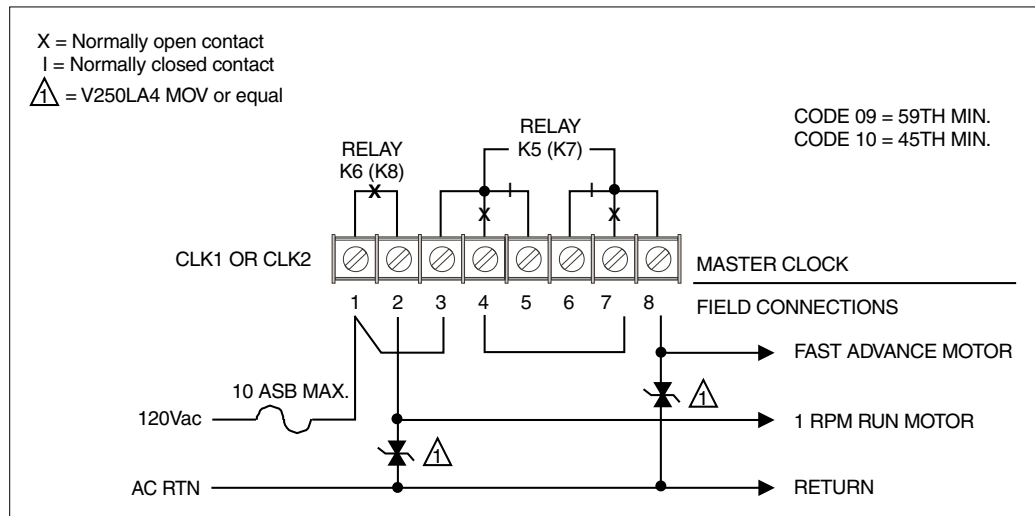


Figure B-12  
Simplex 59th and 45th, Dual Motors



## TYPE 11—Edwards Dual Motor

Power is applied only through relay K6 to the run motor for normal timekeeping. During power interruptions (while clocks are stopped) and during correction, the master clock accumulates the number of seconds. Immediately after power is restored, both relays K6 and K5 operate. Relay K5 applies power to the 10 RPM motor for 1/10th the number of seconds accumulated, causing the clocks to advance to the correct time. After correction, relay K5 opens and relay K6 continues to operate.

For daylight saving, the master either automatically de-energizes relay K6 to cause the clocks to lose one hour, or energizes K5 for approximately six minutes and 40 seconds to advance the clocks one hour.

If the clocks lose their synchronization with the master clock, they can be manually reset using the [9]=SYNCH. CLOCKS function. See page 3-5.

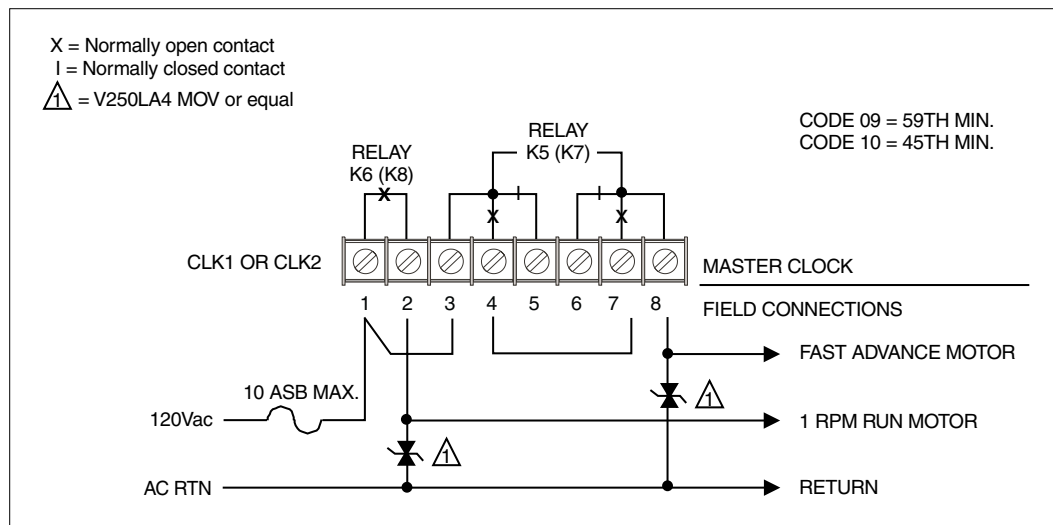


Figure B-13  
Edwards Dual Motor

## TYPE 12—Cincinnati D6 Clocks

Normal pulsing is sent out on lines A and C from second 58 through second 00 each minute. From minute 59 through minute 49, line A is positive with respect to line C. From minute 50 through minute 58, except from 4:49 through 5:55 AM and PM, line C is positive with respect to line A.

To provide hourly corrections, 20 rapid pulses at 0.5Hz are transmitted on lines A and C, line C being positive with respect to line A, during the 59th minute of each hour from second 10 through second 50.

To provide twelve-hour corrections, 20 rapid pulses at 0.5Hz are transmitted from second 10 through second 54 of each minute from 5:00:10 through 5:30:54 AM and PM.

Manual clock advances and daylight saving advances cause the master clock to transmit 62 pulses (one second ON and one second OFF at 0.5Hz). The first five pulses are transmitted with line A positive with respect to line C. The remainder of the pulses are transmitted with line A negative with respect to line C. Normal minute pulses are inhibited during these pulses.

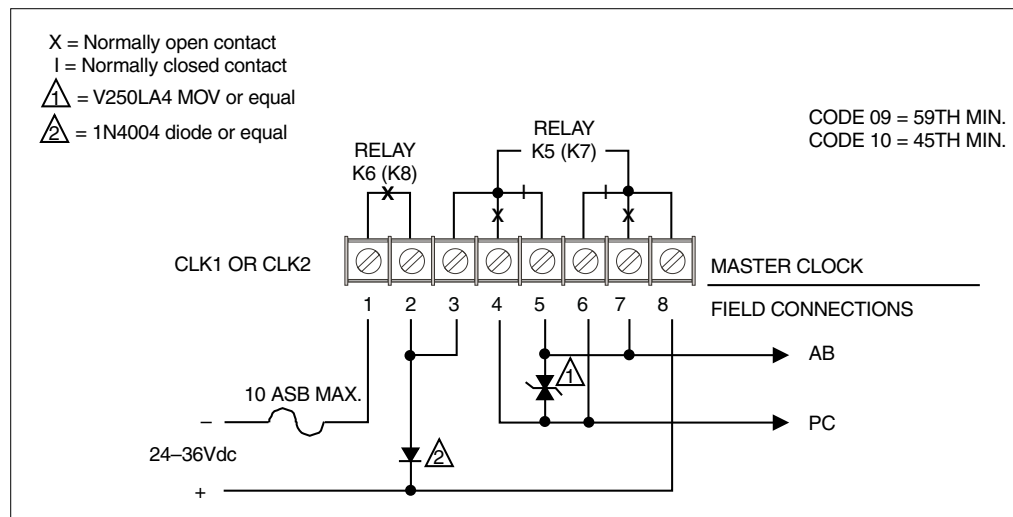


Figure B-14  
 Cincinnati D6 Clocks

## TYPE 13—Two-Wire Pulse Alternating (24Vdc)

Every minute from 59 seconds to 00 seconds, a 24Vdc signal is applied on lines A and B, causing the clocks to advance one minute. The polarity of the pulse is alternated each minute to cause A to be positive with respect to B one minute, then B positive with respect to A the next minute, and so on.

During power interruptions, the master clock accumulates the number of minutes lost. When power is restored, the master clock sends 30 pulses per minute to correct the clocks. The clocks can be manually advanced 60 minutes using the master clock. A total of 62 pulses are issued during manual advance (two normal pulses plus 60 extra advance pulses).

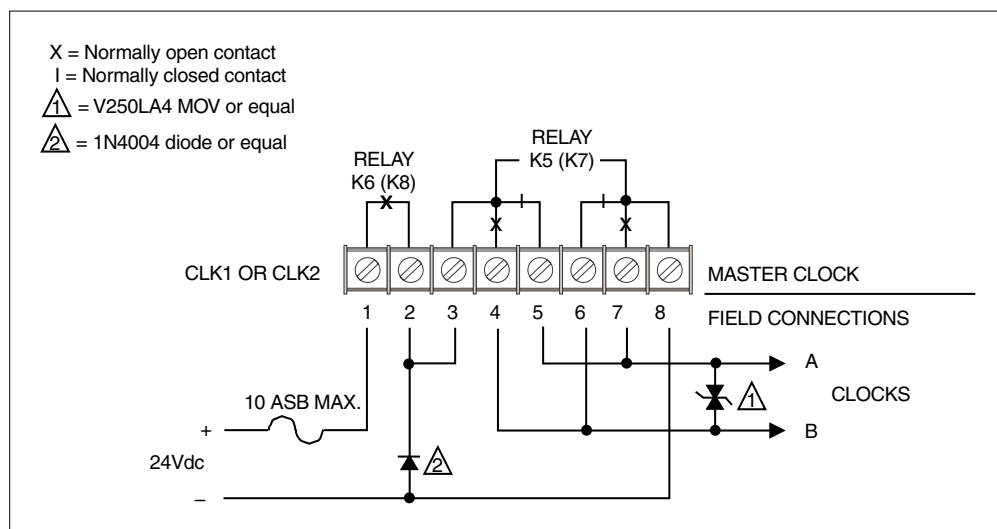


Figure B-15  
Two-Wire Pulse Alternating (24Vdc)

## TYPE 14—Electronic Coded Clocks

Clocks normally run with 120Vac power. For bells or clock correction, the generator prestart relay (K6) first turns on for the signal generator to reach frequency. K6 turns on at the 00 second after a programmed time or manual bell time. Then relay K5 turns on for three seconds, from the 10th to the 13th second, to apply the generator signal (coded cup start signal) onto the 120Vac. Bell circuits then turn on for three seconds, in the order listed below, applying the generator signal onto the 120Vac for decoding by the coded cups.

The bell relay contacts must connect in parallel with the normally open contacts of relay K5. If it is not time for a clock correction signal, K6 turns off at the 59th second. At the 57th minute of each hour, K5 turns on from 57:54 to 58:02, applying the 8-second hourly correction generator signal onto the 120Vac. At 5:57 AM and 5:57 PM (12-hr correction), K5 turns on from 5:57:54 to 5:58:08, applying a 14-second 12-hour correction generator signal onto the 120Vac. For daylight saving, the clocks advance to the proper time by normal 12-hour correction, not at 2:00 AM. See **Figure B-16** on page B-19.

The time sequence of each relay operation is listed below.

Relay	From	To	From	To
K6 Generator Prestart (hourly correction)	HH:57:00			H:59:00
K5 Start Signal (hourly correction)	HH:57:00	HH:57:13	HH:57:54	HH:58:02
K6 Generator Prestart (12-hour correction)	HH:57:00			HH:59:00
K5 Start Signal (12-hour correction)	5:57:10	5:57:13	5:57:54	5:58:08
K6 Generator Prestart (bells)	HH:MM:00	HH:MM:59		
K5 Start Signal (bells)	HH:MM:10	HH:MM:13		
Bell Circuit 6	HH:MM:20	HH:MM:23		
Bell Circuit 5	HH:MM:25	HH:MM:28		
Bell Circuit 4	HH:MM:30	HH:MM:33		
Bell Circuit 3	HH:MM:35	HH:MM:38		
Bell Circuit 2	HH:MM:40	HH:MM:43		
Bell Circuit 1	HH:MM:45	HH:MM:48		

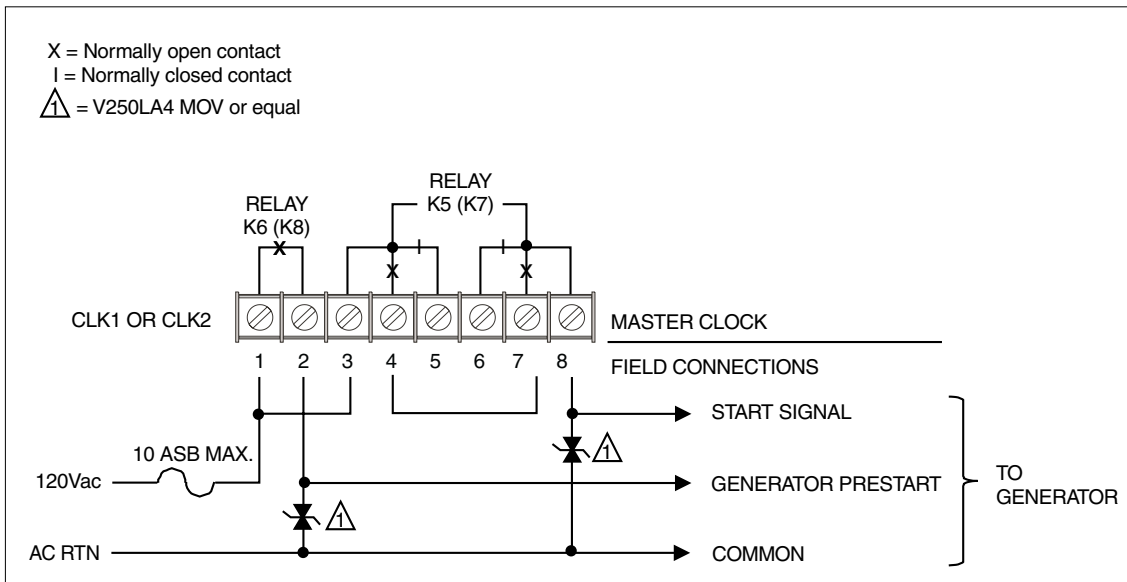


Figure B-16  
 Electronic Coded Clocks

## TYPE 15—Straight Frequency

Clock correction and bell circuit operations are generated by sequentially applying various frequencies onto the 120Vac. Each bell and clock correction circuit has its own frequency and a receiver circuit that applies the associated bell or clock frequency (3,510Hz normally used for clock signals). The daylight saving feature advances clocks correctly but has no means, other than normal 12-hour correction, to correct secondary clocks at 2:00 AM. The time sequence of applying the frequencies to the 120Vac is shown below and is controlled by the bell and system relays in the master clock.

Relay	From	To
Bell Circuit 1	HH:MM:00	HH:MM:05
Bell Circuit 2	HH:MM:05	HH:MM:10
Bell Circuit 3	HH:MM:10	HH:MM:15
Bell Circuit 4	HH:MM:15	HH:MM:20
Bell Circuit 5	HH:MM:20	HH:MM:25
Bell Circuit 6	HH:MM:25	HH:MM:30
K5 (hourly correction)	HH:57:54	HH:58:02
K5 (12-hour correction)	5:57:54	5:58:08
K6 (hourly and 12-hour corr.)	HH:57:00	HH:59:00
K6 (bells)	35th second of minute previous to bell	30th second of bell time

**Note:**

Bells must be programmed one minute ahead of desired time. Bells are inhibited during the 58th minute and will not work during manual clock corrections either.

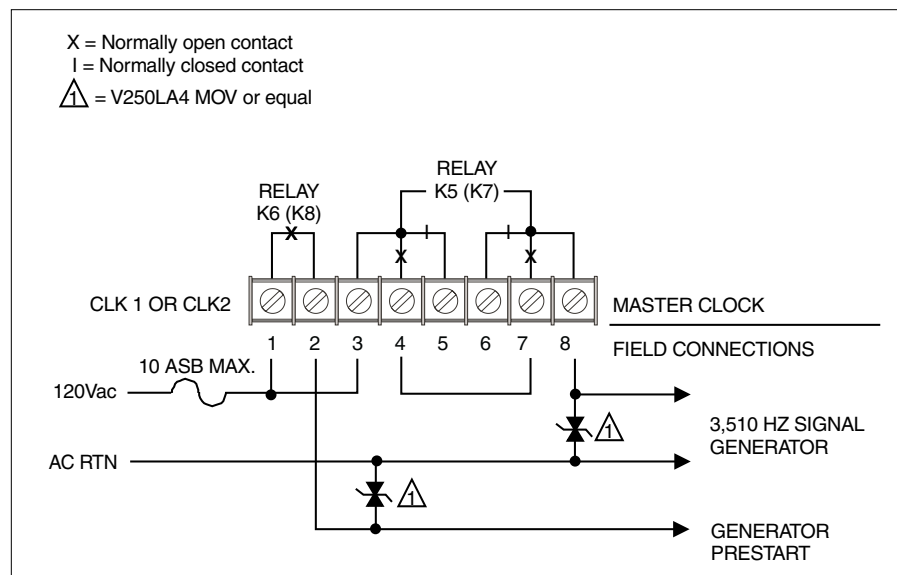


Figure B-17  
Straight Frequency



## TYPE 16—Two-Wire Reverse Polarity Minute Impulse (59th Minute) with 12-Hour Correction

There are two types of type 16 secondary clocks: the two-wire reverse polarity minute impulse covered on this page, and the three-wire minute impulse on the previous page.

Each hour, from the 59th minute through the 49th minute, a two-second pulse is transmitted between lines AB and PC (with AB positive with respect to PC), starting at the 58th second and ending at 00 second. This causes all clocks to advance each minute. From the 50th minute to the 59th minute, transmission is such that PC is positive with respect to AB. Clocks that are less than 10 minutes fast stop at the 59th minute, since their SR contacts transfer and require a pulse with AB positive with respect to PC to advance at this time.

Each hour, starting at the 59th minute and 10 seconds, 20 rapid pulses at 0.5Hz are transmitted with line PC positive with respect to AB. Slow clocks are advanced at this pace. Every 12 hours, from 6:02 through 6:44, 23 rapid pulses are transmitted each minute, line PC positive with respect to line AB, with transmission starting at 10 seconds after and ending at 55 seconds after. Clocks that are more than one hour slow are rapidly advanced to the correct time.

Manual clock advances and daylight saving advances cause the master clock to transmit 62 pulses (one second ON and one second OFF at 0.5Hz). The first five pulses are transmitted with line AB negative with respect to line PC. Normal minute pulses are inhibited during these pulses. Types of secondary clocks covered by this configuration are the same as under three-wire on the previous page.

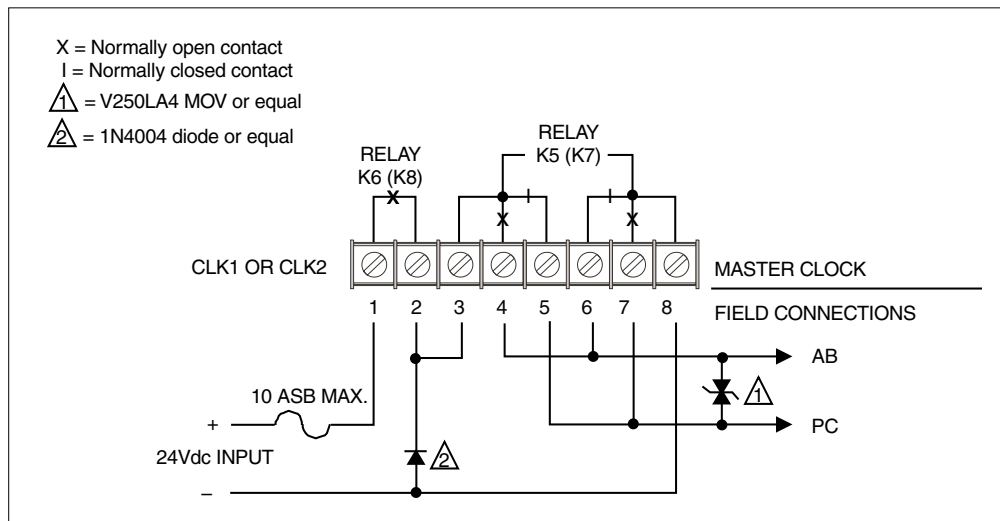


Figure B-19  
Two-Wire Minute Impulse (59th Minute) with 12-Hour Correction



## TYPE 17—Standard Electric Time AR-3 Three-Wire Impulse

Each minute from 58 seconds to 00 seconds, a pulse is transmitted on line. The secondary clocks receive the pulses on line A until the 58th minute. At this time, from 50 seconds to 00 seconds, a pulse on line B is required to advance to the 59th minute.

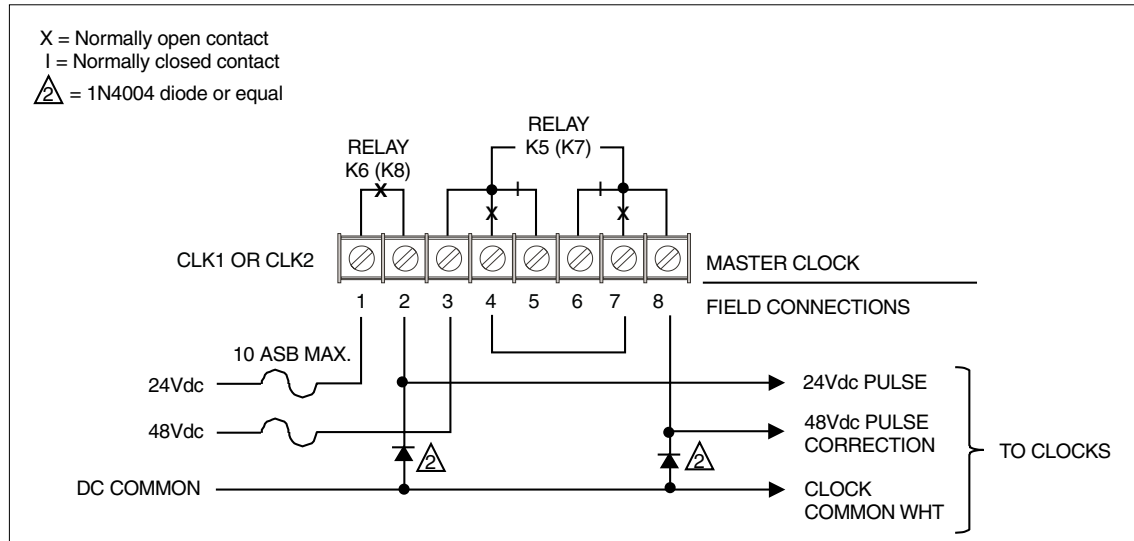


Figure B-20  
 Standard Electric Time AR-3 Three-Wire Impulse

## TYPE 18—National Synchronous Wired

For a list of Type 18 clocks, see the chart on the first page of this appendix.

Relay K5 is normally operated to power the clock run motors. Each hour from HH:00:00 to HH:00:28, relay K6 is operated to power the clock correction coils for 28 seconds and cause hourly corrections. Every 12 hours, from 6:00:00 to 6:27:27, relay K6 is again operated to power the clock correction coils for 27 minutes, causing 12-hour correction.

Manual clock corrections can be issued from the master during any even-numbered minute except 00.

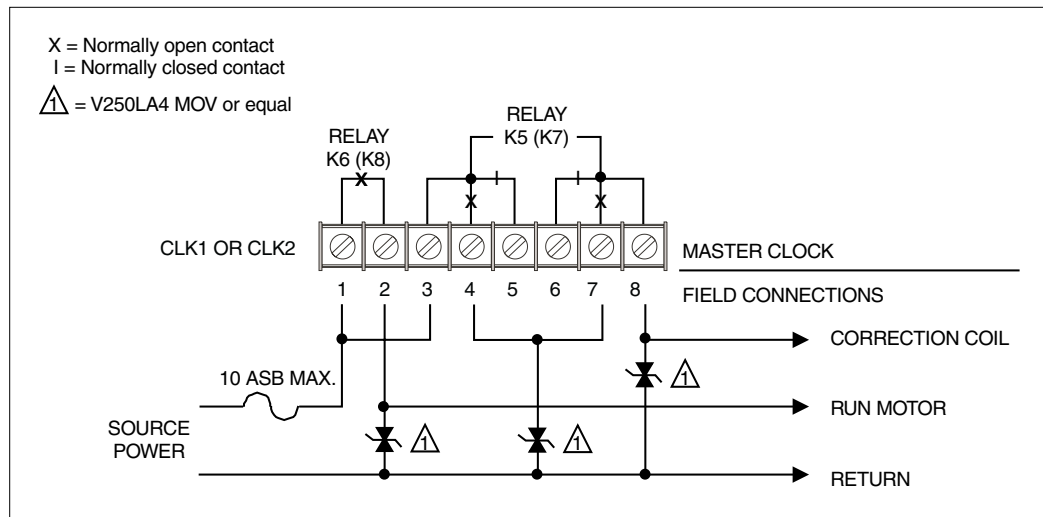


Figure B-21  
 National Synchronous Wired

## TYPE 19—Stromberg Synchronous Wired (56th Minute)

For a list of Type 19 clocks, see the chart on the first page of this appendix.

This clock is normally operated by 120Vac/24Vac. Relay K5 is normally operated to supply motor power. Relay K6 activates each hour from HH:56:10 to HH:56:18, causing an eight-second signal to be transmitted on the correction line for hourly correction. Relay K6 activates every 12 hours, from 11:56:36 to 11:56:50, causing an additional 14-second signal to be transmitted on the correction line for 12-hour correction. During power interruptions and automatic clock resetting, relay K5 is deactivated.

**Note:**

Lathem SS Modified wall clocks operate according to the above signal operation if modified to reference the minute and second hands to HH:57:16 (versus HH:59:00) and the hour hand to 12:00 (versus 6:00).

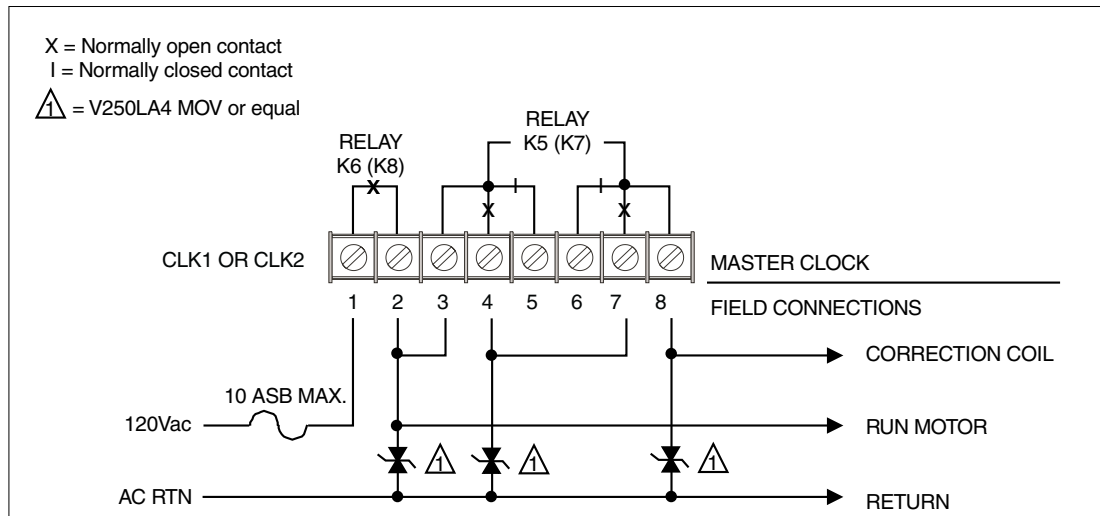


Figure B-22  
Stromberg Synchronous Wired (56th Minute)

## TYPE 20—Three-Wire Minute Impulse (44th Minute)

Every minute, from the 58th second to 00 seconds, a 24Vdc pulse is transmitted to the secondary clocks. From the 44th minute through the 34th minute, the pulse is transmitted on the A and B lines. From the 35th minute to the 44th minute, the pulse is transmitted on the A line only. Clocks that reach the 44th minute ahead of the master clock stop, since at this time they respond only to pulses transmitted on the B line. During the 44th minute, from 10 seconds through the 50th second, 20 rapid pulses are transmitted at 0.5Hz on the A line to advance all slow clocks.

Manual clock advances and daylight saving advances cause the master clock to transmit 62 pulses (one second ON and one second OFF at 0.5Hz). The first five pulses are transmitted on lines A and B. The remainder of the pulses are transmitted on line A only. Normal minute pulses are inhibited during these pulses.

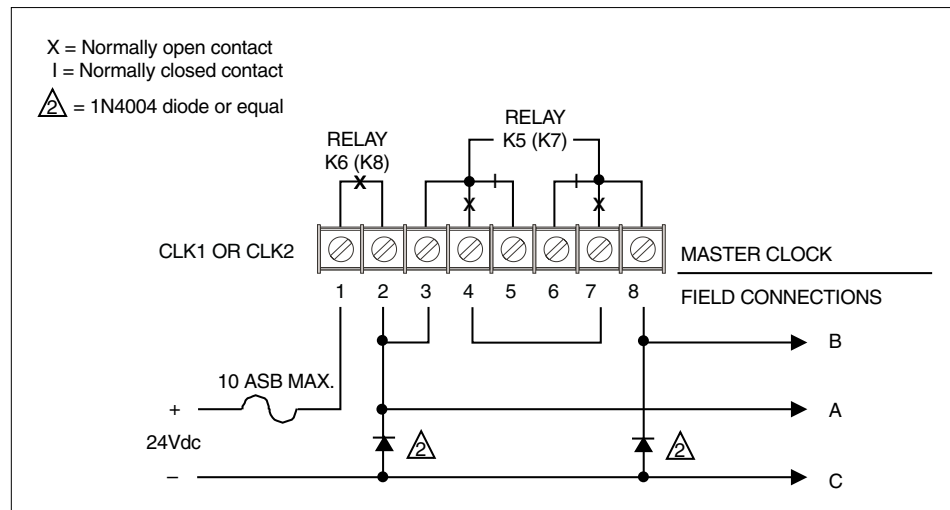


Figure B-23  
Three-Wire Minute Impulse (44th Minute)

## TYPE 21—Cincinnati D1

Every minute, from HH:MM:58 to HH:MM:00, relay K6 is activated, causing an output on line A for two seconds. During minutes 07 through 58 only relay K6 activates, causing the output on line A to be 24Vdc.

During minutes 59 through 06, relay K5 is also activated, together with relay K6, causing the output on line A to be 60Vdc to advance all clocks. Clocks that reach the 59th minute ahead of the master clock stop, since at this time they respond only to the 60Vdc pulses.

Hourly corrections occur during minute 59 from HH:59:10 through HH:59:49. During hourly corrections, 20 rapid pulses of 24Vdc are output on line A at 0.5Hz, causing all slow clocks to rapidly advance. All secondary clocks at minutes 59, 00, or 01 do not respond to the 24Vdc, but hold until the 60Vdc signal advances them. Manual clock advances cause a total of 62 pulses on the A line; the first five are 60Vdc and the remainder are 24Vdc.

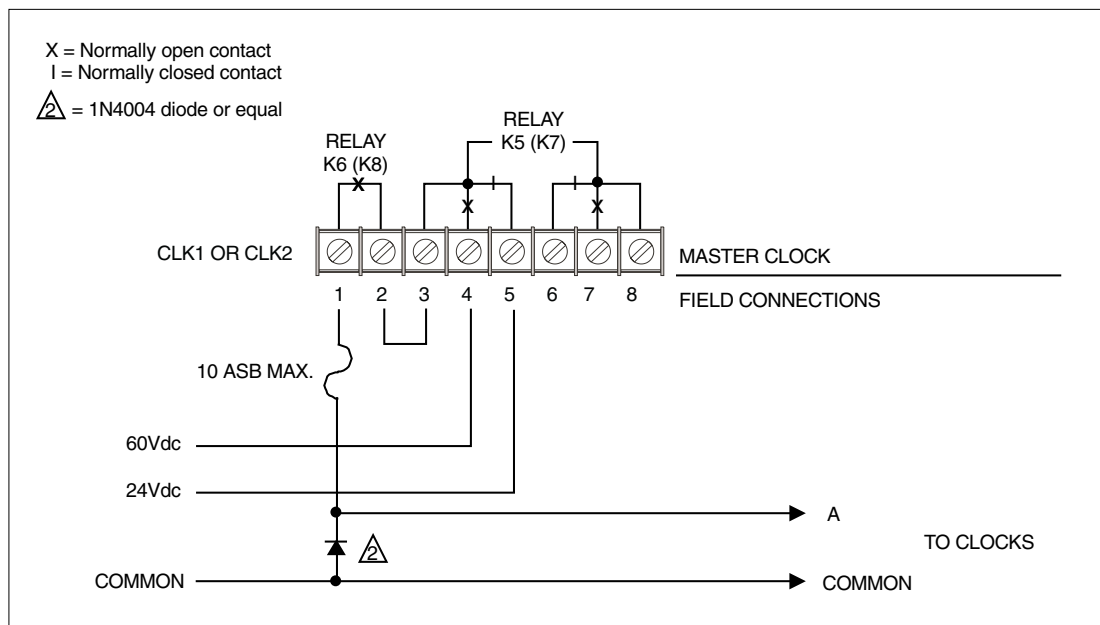


Figure B-24  
Cincinnati D1

## TYPE 22—Dukane Synchronous Wired (24A Series, Obsolete)

During normal operation, either 24Vac or 120Vac is furnished to the clock run motor through relay K6. Power is removed from the run motor during power failures, while K6 de-energizes during fall daylight saving changes.

Each hour from HH:57:00 to HH:57:55, relay K5 energizes to furnish a 24Vdc signal to the correction coil. This 55-second signal causes all secondary clocks to advance to the 58th minute, thus synchronizing the seconds and minutes with the master clock. The 12-hour correction occurs twice daily, beginning at 5:59:00. Every other minute from 5:59:00 through 6:19:55, relay K5 energizes to furnish eleven 24Vdc signals of 55 seconds duration to the clock correction coils (5:59:00 to 5:59:55, 6:03:00 to 6:03:55, 6:19:00 to 6:19:55).

These eleven signals cause all secondary clocks up to 11 hours behind to advance to 5:58:00. Hours, minutes, and seconds are synchronized to the master clock after the next hourly correction at 6:58:00. Clocks more than 11 hours behind prior to a 12-hour correction require two 12-hour corrections to advance to 5:58:00.

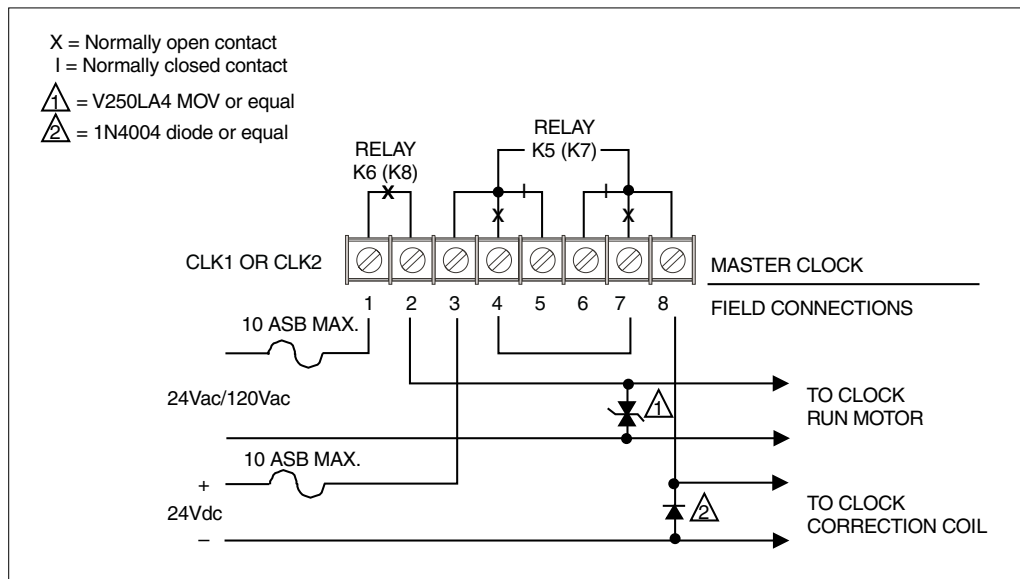


Figure B-25  
 Dukane Synchronous Wired (24A Series, Obsolete)

## TYPE 23—Condor Digital Clocks (Model 2412)

For a list of Type 23 clocks, see the chart on the first page of this appendix.

Condor digital clocks initialize to 12:00 AM when power is first applied. During normal operations, the clocks maintain time by counting the 60Hz AC line frequency. When the line voltage drops to approximately two-thirds normal level, the clocks start rapidly advancing at a rate of two minutes per second. After applying power to the master clock and entering system selection code 23, the master clock initializes to 12:00 AM.

Every twelve hours, at 11:59:56 AM and 11:59:56 PM, the master clock drops K6, removing power from the clocks. At 00 seconds, K6 resumes operation, applying full power to the clocks, which synchronizes them and corrects their displays to 12:00.

After time resets, manual clock advances, daylight saving changes, and power failures, the master clock drops K6 at the following 56th second to disconnect power to the clocks. At 00 seconds, K6 resumes operation, applying full power to the clocks and causing them to display 12:00. At 02 seconds, K5 operates to furnish low voltage to the clocks, causing them to fast advance at a rate of two minutes per second. When the new time is reached, K5 is dropped, furnishing full power to the clocks for normal operation.

If the digital clocks become unsynchronized with the master clock, they can be manually reset using the [9]=SYNCH. CLOCKS function. See page 3-5.

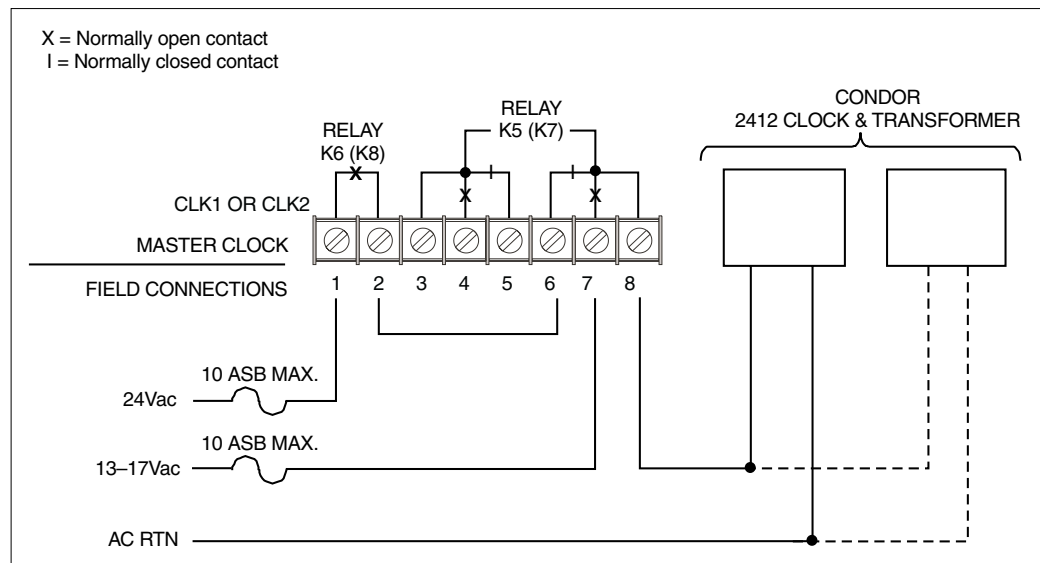


Figure B-26  
Condor Digital Clocks (Model 2412)

## TYPE 24—Edwards Synchronous Wired Clocks, Type E1

During normal operation, 120Vac is applied between the run motor and common lines to operate the clocks until the 58th minute. At HH:58:00 of each hour, the 120Vac is replaced by 120Vdc between the correction and common lines for a period of 200ms, with the common line being positive. This pulse initiates hourly corrections for clocks that are less than 60 minutes slow. At 5:58:09 AM and PM, an additional 120Vdc, 200ms pulse is transmitted to correct clocks that are 60 or more minutes slow.

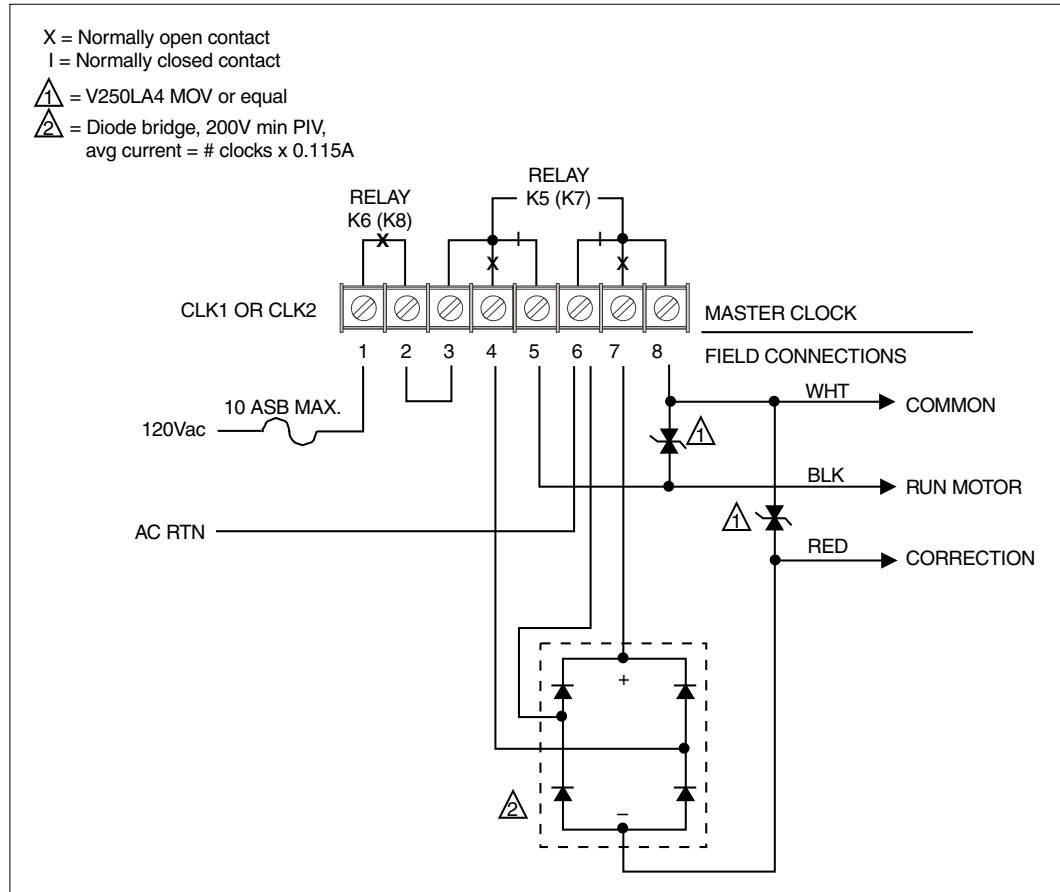


Figure B-27  
Edwards Synchronous Wired Clocks, Type E1



## TYPE 27—Simplex 2310 Dual Motor

Type 27 secondary clocks have the same hourly corrections as type 09, with the addition of 12-hour corrections as for type 03.

Power is normally applied to the 1 RPM run motor. Each hour, from HH:58:05 through HH:58:59, power is removed from the run motor and applied to the fast advance motor. During manual clock corrections, power is applied to both motors for 4 minutes and 15 seconds.

During normal operation, 120Vac is applied to the run motor. A 15-minute correction signal on the correction motor line causes a 12-hour correction from 5:12:00 to 5:28:00. This occurs twice daily (AM and PM). Run motor power is connected during the 12-hour correction. A 29-second signal is applied to the correction motor line from HH:59:30 to HH:59:59 to cause hourly corrections. During hourly corrections, power is disconnected from the run motor line.

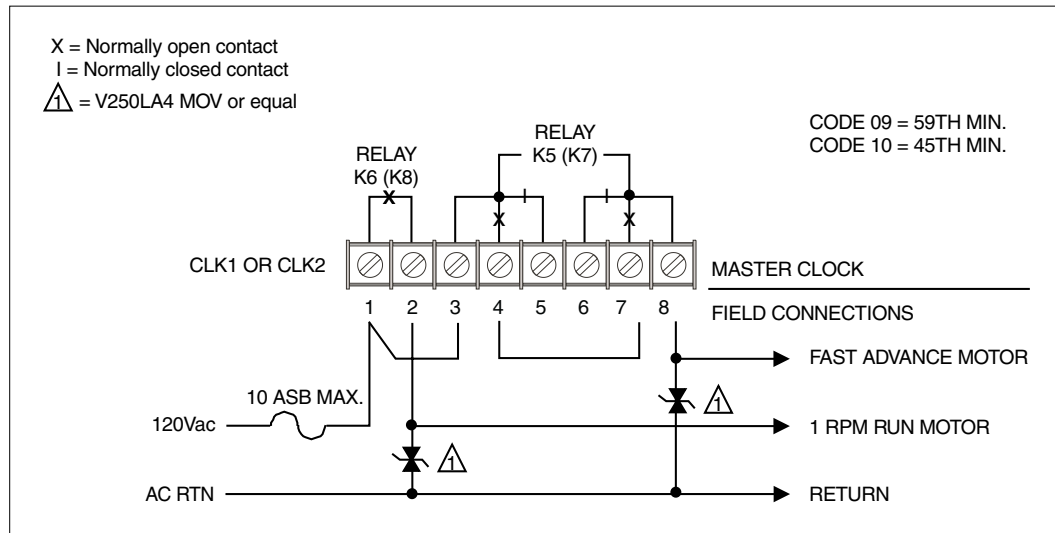


Figure B-28  
Simplex 2310 Dual Motor

## Types 28, 29, and 30

For wiring information on Type 28 (Stromberg 12-hour), Type 29 (Type 01 Special), and Type 30 (Type 14 Special) clocks, contact Lathem Time Corporation.

## *Notes*

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## Wiring Diagrams List

This appendix contains wiring information and diagrams for the installation of the Dukane 24A715/M Master Clock:

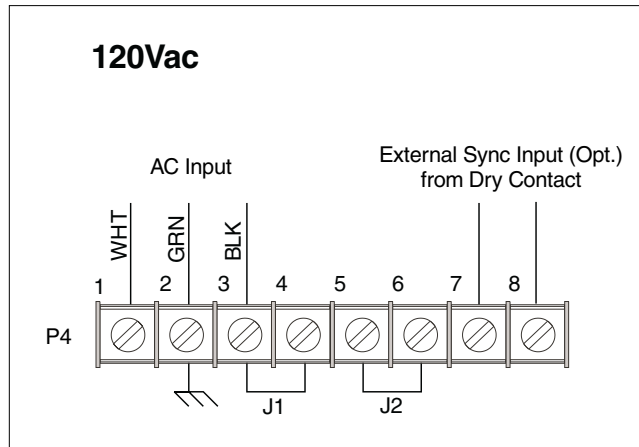
C-1	Wiring the 24A715/M for 120Vac Operation. . . . .	C-2
C-2	Wiring the 24A715/M for 220/240Vac Operation . . . . .	C-2
C-3	Typical Signal Device Wiring—Terminal Block P1 . . . . .	C-3
C-4	Typical Signal Device Wiring—Terminal Block P2 . . . . .	C-3
C-5	Typical Signal Device Wiring—Terminal Block P3 . . . . .	C-3
C-6	The Communications Terminal Block . . . . .	C-4
C-7	RS-232 Cable for Permanent Connection to the Communications Terminal Block . . . . .	C-5
C-8	Synchronizing RS-485 Time Synchronization Devices Without a Buffer . . . . .	C-6
C-9	Using the Master Clock as a Slave to Allow 30 Extra RS-485 Time Synchronizing Devices . . . . .	C-6
C-10	Example of Cable Strain Relief . . . . .	C-7
C-11	Computer Cable for Front Access Port . . . . .	C-8

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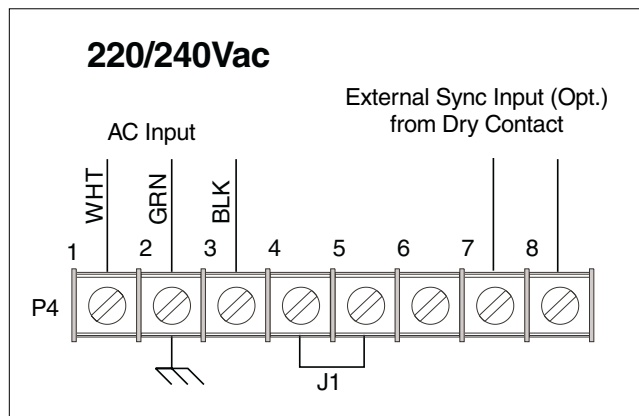
## Wiring the Master Clock for 120Vac or 220/240Vac

The master clock is factory-shipped ready for 120Vac. **Figure C-1** shows the correct wiring for 120Vac operation. **Figure C-2** shows the correct wiring and adjusted jumper settings for 220 and 240Vac operation.

All circuits should be fused or protected by a circuit breaker (10-amp maximum).



*Figure C-1*  
*Wiring the 24A715/M for 120Vac Operation*

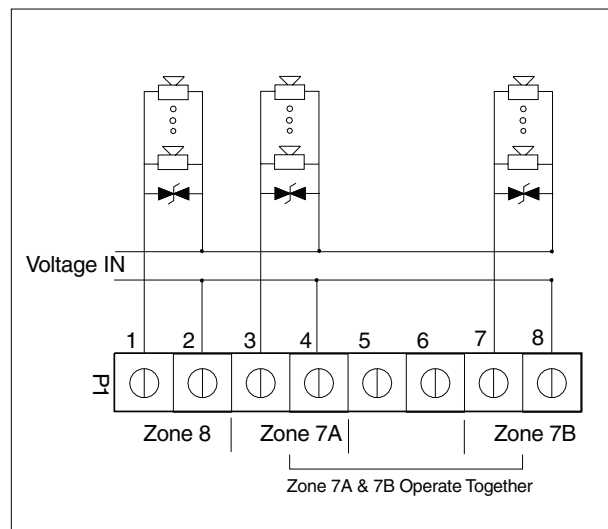


*Figure C-2*  
*Wiring the 24A715/M for 220/240Vac Operation*

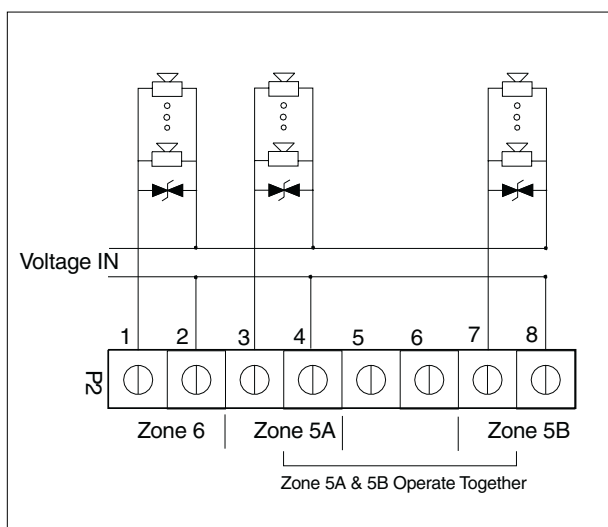
# Wiring Signal Devices to the Master Clock

Typically, signal devices (such as bells or lights) are wired to terminal block P3. If no secondary clocks are connected to terminal blocks P1 or P2, signal devices can also be wired to those blocks. See the figures below.

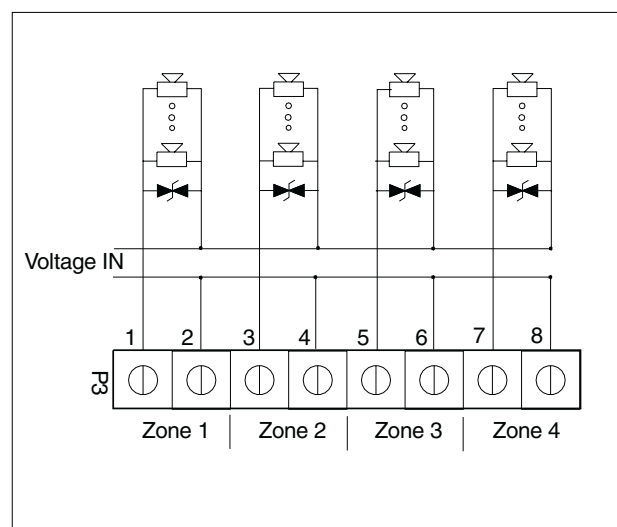
Zone 7A and 7B operate together, and 5A and 5B operate together. You can use either of these circuits for bells. All circuits should be fused or protected by a circuit breaker (10A maximum).



*Figure C-3*  
*Typical Signal Device Wiring—Terminal Block P1*



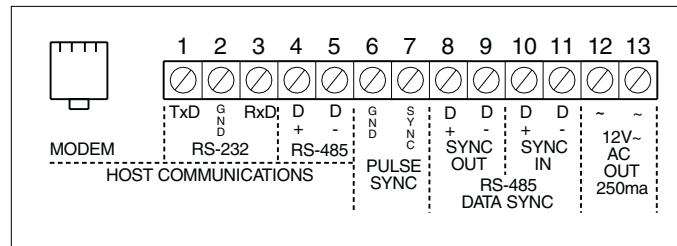
*Figure C-4*  
*Typical Signal Device Wiring—Terminal Block P2*



*Figure C-5*  
*Typical Signal Device Wiring—Terminal Block P3*

## Wiring the Communications Terminal Block

The communications terminal block is on the back of the display unit. See **Figure C-6**. It is used to connect the optional modem, a computer, any RS-485 devices, and a power source for the optional remove schedule selector.



*Figure C-6*  
*The Communications Terminal Block*

When making connections to the communications terminal block, keep the following in mind:

- Twisted-pair (Cat-3/Cat-5) wire connects directly to the terminal block, with up to two wires per position.
- The pulse-sync input is the same as provided in the power supply. A one-second (minimum) dry-contact switch closure across the terminals will cause the master clock to reset the time to 12:00 AM of the nearest date.
- Grounds (GND) are signal grounds, not chassis grounds.

## Wiring the Host Communications Terminals

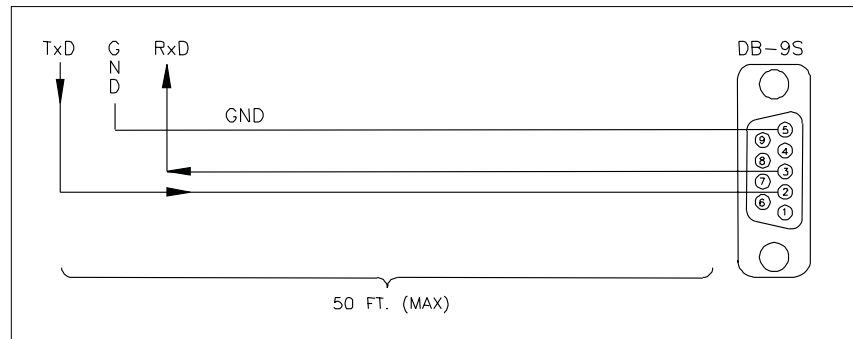
The host communications terminals on the communications terminal block include:

RS-232—Three terminal block contacts for RS-232 communications with an IBM-compatible computer running the optional Lathem MasterLink programming software.

### Notes:

This terminal is typically used for a permanent connection to a computer. To make a cable to connect the computer to the RS-232 terminals, see **Figure C-7** on page C-5.

For a temporary computer connection, see **Connecting a Computer to the Front Access Port** on page C-8.



*Figure C-7*  
*RS-232 Cable for Permanent Connection*  
*to the Communications Terminal Block*

RS-485—Terminal block pair for RS-485 communications with an IBM-compatible computer running the optional Lathem MasterLink programming software and SWIFT (RS-485 to RS-232 converter).

MODEM—Modular connector for modem use. The optional internal modem can be used to dial out to the Atomic Clock at Fort Collins, Colorado, USA, or for a remote site using the optional Lathem MasterLink programming software.

## Wiring the DDC4R Communications Terminals

The DDC4R communications terminals on the communications terminal block include:

SYNC IN—Terminal block pair used to receive RS-485 synchronization from another Dukane master product or radio synchronization device, or to transmit the 24A715/M synchronization commands to up to 30 RS-485 devices, including master and wall clocks.

SYNC OUT—Terminal block pair used to buffer and repeat a received RS-485 synchronization signal, or to transmit the 24A715/M synchronization commands to up to 30 additional RS-485 devices.

### Notes:

When first powered on, the 24A715/M monitors the SYNC IN line to determine if it should be a master or a slave. If it does not receive a time update for 15 minutes, it assumes it is a master and starts transmitting the time signal on the RS-485 synchronization line every minute. It will re-evaluate its master/slave status every day at the 00:00 hour.

When setting up the master/slave system, make sure you apply power to the master first, and connect the other 24A715/M to the SYNC OUT port on that clock.

### Wiring RS-485 Time Synchronization Devices

Up to 30 RS-485 Data Synchronization Devices (DSDs) can be connected to the sync terminals. Since the SYNC IN port can send as well as receive, 30 extra devices can be connected. If more than 60 DSDs are to be connected, another master clock must be used as a booster.

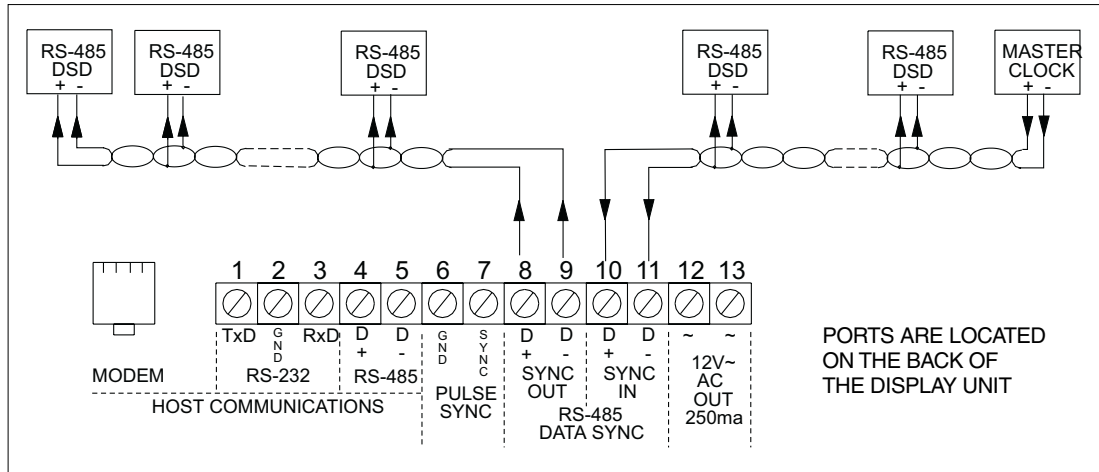


Figure C-8

Synchronizing RS-485 Time Synchronization Devices Without a Buffer

### Using the Master Clock as a Slave

Since the SYNC IN port can send as well as receive, 30 extra devices can connect here. If you already have a master source, connect it and its string of clocks to the SYNC IN port for a total of up to 60 devices.

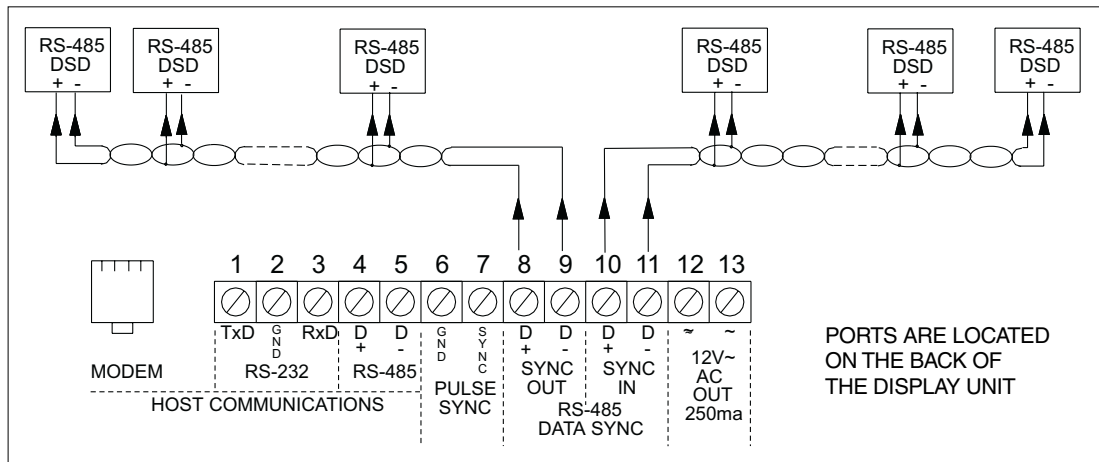


Figure C-9

Using the Master Clock as a Slave to Allow 30 Extra RS-485 Time Synchronizing Devices



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## Wiring the 12 Volt AC Out Terminals

The 12 Volt AC Out Terminals connect to a non-regulated 12V 250mA power source and are used with the optional remote schedule selector (available from Lathem) when in close proximity to the master clock. Contact Lathem Time Corporation for details.

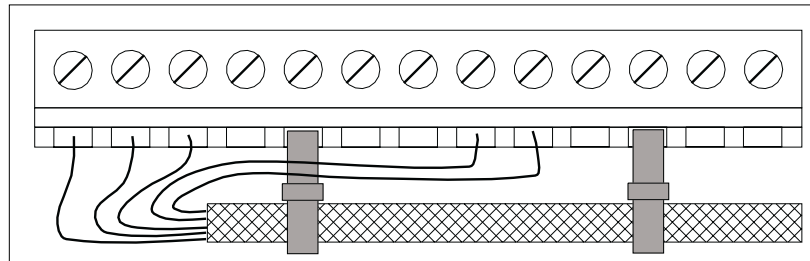


**—WARNING—**

**This circuit is not fused separately.  
Attaching devices with a higher current  
load may damage the master clock.**

## Strain Relief for the Communications Cable

Attach the two wire tie wraps included in the installation kit to the terminal block as shown to provide strain relief to the communications cable. Use any two empty positions.



*Figure C-10  
Example of Cable Strain Relief*

# Connecting a Computer to the Front Access Port

A computer can be temporarily connected to the master clock via the front access port. See the figure below to make a cable for this purpose.

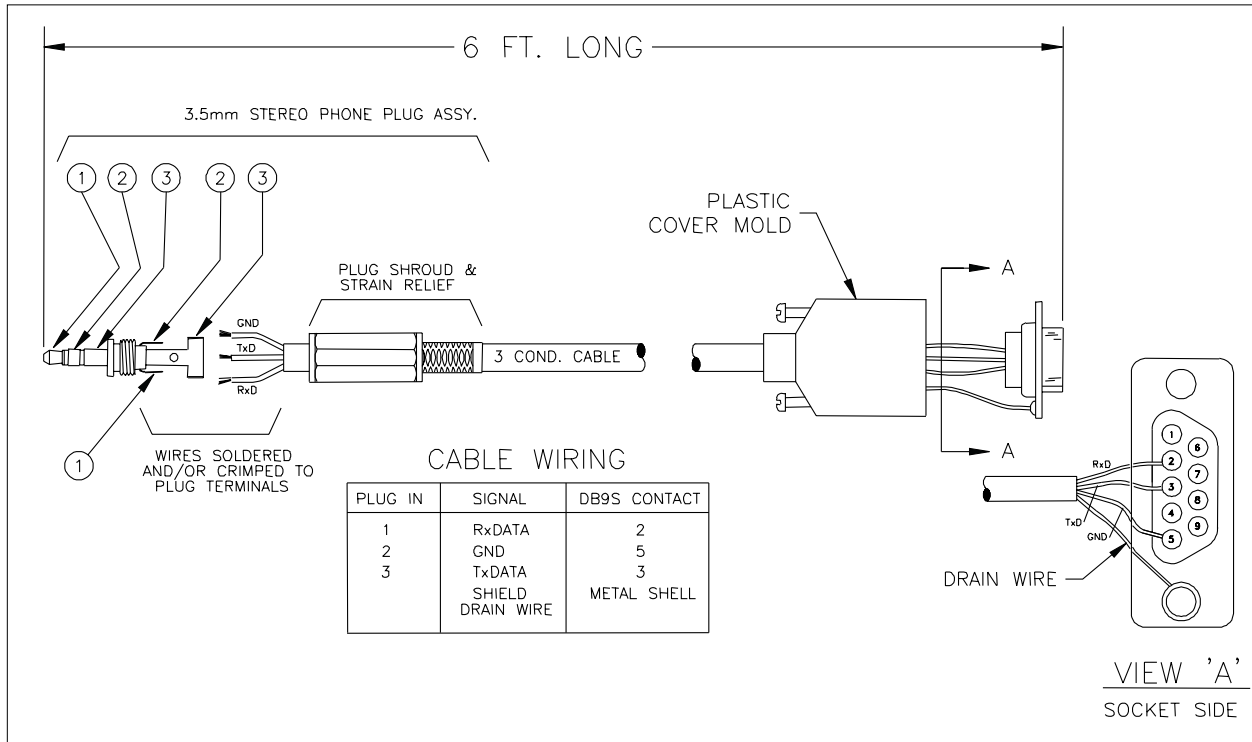


Figure C-11  
Computer Cable for Front Access Port

# Appendix D Power Supply Schematic

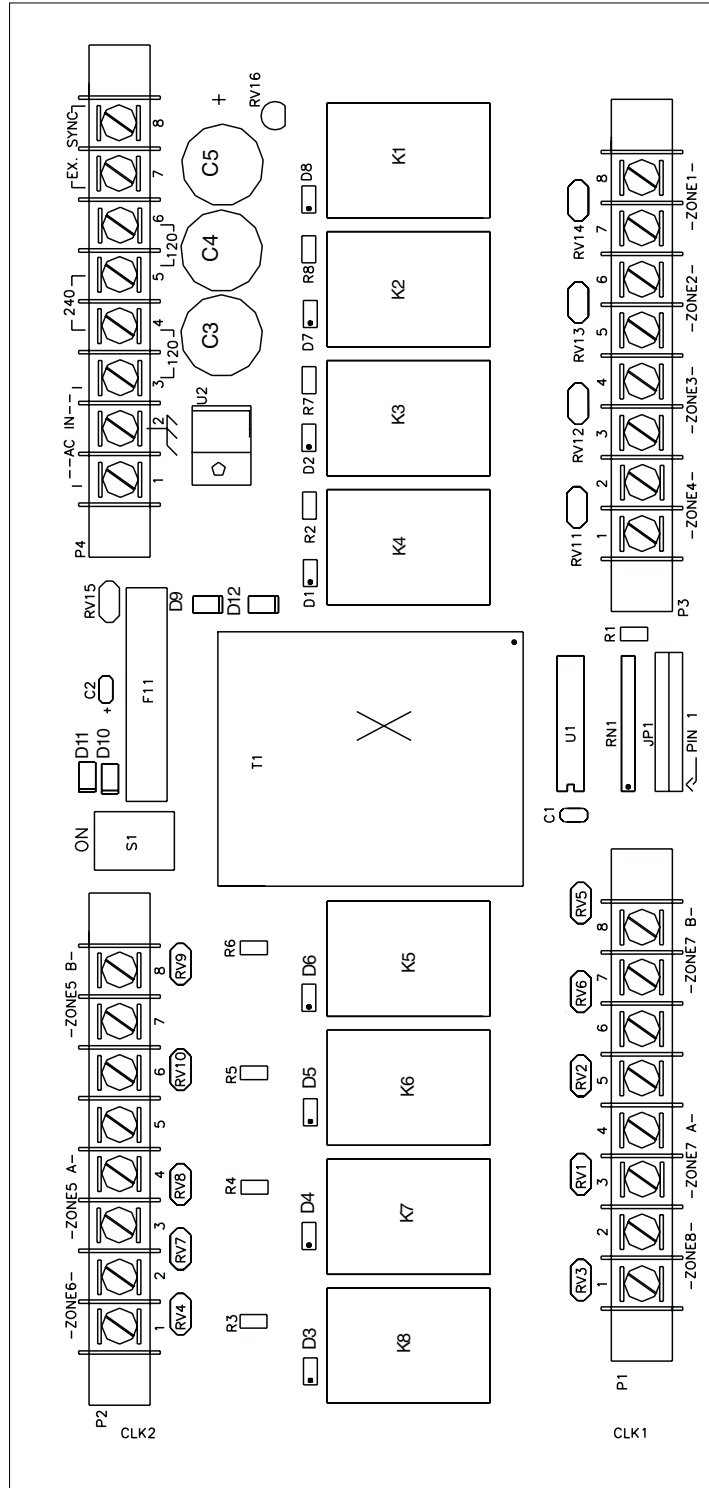


Figure D-1  
Power Supply Schematic for the 24A715/M Master Clock

## *Notes*

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***DUKANE CORPORATION***

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COMMUNICATIONS SYSTEMS DIVISION - 2900 Dukane Drive, St. Charles, Illinois 60174

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