

*User Manual*

# **CYCLOCHRON**

*order number code : CYCSP2, CYCSP3, etc.*

*Documentation release version 1.0*

*by Raymond Weisling*



# THE CYCLOCHRON

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## HISTORY

The Cyclochron was conceptually created in 1980, based on the concept that a chaser light sequence shows motion and if formed into a circle with part of the circle moving in the opposing direction, two points — an origin or divergence, and a destination or convergence—can indicate two different points, to indicate hours and minutes. Certain technical aspects of its design were sketched out in 1981 and 1982. Some assembler programming was done for the 6502 microprocessor around that time, but no hardware construction was attempted due to logistics. The actual full-on design had to wait for 1990, when we had access and development tools for a small footprint microcontroller. It was shown to possible sales channels in Europe and California, but interest remained low—we just had not found the right channel. The Internet is now the perfect venue to connect unusual customer tastes and demands with unique products such as this.

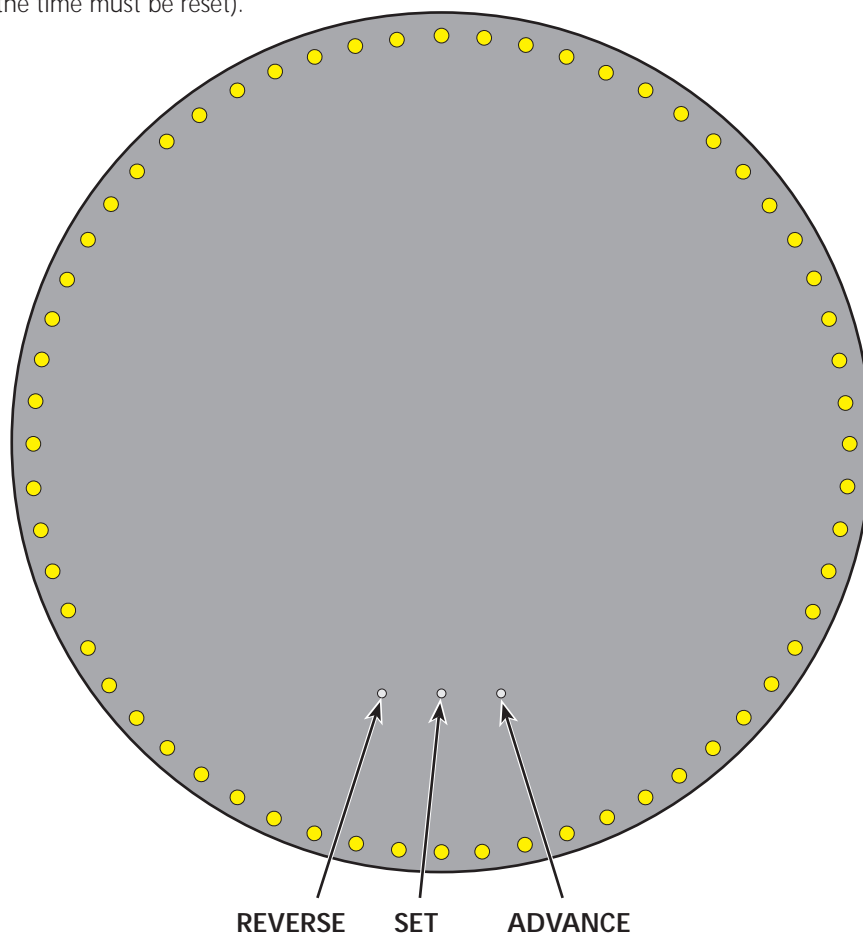
## OPERATION OVERVIEW

When the Cyclochron is first turned on it will be preset to 05:59:30, and 30 seconds later, at 06:00:00 the chime will sound for six hours. Once the time is set, it will operate continuously, unless power fails. For further information on what it does when power fails, see the section BATTERY BACKUP. Additional notes on the details of the chaser display are described in the READING TIME and DISPLAY DETAILS sections.

## USER SETTINGS

There are three very small holes in the faceplate just below the centre. These provide access to three internal tactile switches. The left switch is the REVERSE button, the centre one is the SET button, and the right button is the ADVANCE button.

By means of these three buttons you can set the time and set internal preferences, which will hold through a power failure (even if the time must be reset).



## SETTING THE CLOCK

The SET button cycles through five different setting modes or steps. These are outlined in Table 1 on the next page. The first three steps are used for setting the time, first to 0–11 hours (AM) or 12–23 hours (PM), second for the hour and lastly for the minute.

### NOTE

*The Cyclochron operates internally on a 24-hour clock. The purpose of the 24-hour clock cycle is so that chime tone occurrence levels can be established for each hour of the day. If this is unimportant to you, then you can ignore the morning and afternoon (AM and PM) indications.*

## SETTING AM or PM

The first step in the setting cycle illuminates three LEDs either to the left or right of the 12-o'clock position. The metaphor used here is before noon or after noon, referring to the hours 0–11 (AM) or 12–23 (PM). The REVERSE or SET buttons will alternate between the two indications. Select the current 12-hour period and press the SET button to advance to the next setting.

## SETTING HOUR

The second step in the setting cycle illuminates one of twelve LEDs in each of the hour positions. The REVERSE button moves the hours point in reverse, and the ADVANCE button moves it ahead. Select the current hour and press the SET button to advance to the next setting.

## SETTING MINUTE

The third step in the setting cycle illuminates one LED in any of 60 points for the minute. You may have to count the minutes off since there are no visual clues for 5, 10, 15, etc. minute points. It's the Movado tradition. As expected, the REVERSE button moved the minutes in reverse, and the ADVANCE button moves the minute forward. Select the current hour and press the SET button to advance to the next setting.

## SETTING CHIME OCCURRENCE LEVEL

The fourth step in the setting cycle allows you to select which hours will have one, two or four chime tone occurrences, or will have no chime tone sounding. The visual indications here are a little more complex.

Three LEDs to the left or right of the 12-o'clock position represent AM or PM, as in the setting for the correct 12-hour period as explained above. When entering the chime occurrence setting mode, the indication will begin with the midnight hour (00:00 or 12:00 AM). These three LEDs also flash to show the occurrence level for the selected hour.

A single LED illuminates in one of the 12 hour points to also show which hour is being affected.

The ADVANCE button advances the hour through the pre-noon (AM) cycle and then through the afternoon (PM) cycle, and then returns to the AM — it is a full 24-hour circular cycle.

The REVERSE button rotates through four occurrence levels for the current selected hour. These are shown by the number of flashes on the three AM/PM indicators, as follows:

1 flash	chime will only sound on the hour (x:00)
2 flashes	chime will sound on the hour and half-hour (x:00 and x:30)
4 flashes	chime will sound every fifteen minutes (x:00, x:15, x:30 and x:45)
steady	chime will not sound for the hour

When all 24 hours have been programmed for an occurrence level, press the SET button to advance to the next setting.

## SETTING DISPLAY MODE

The fifth and last step in the setting cycle allows you to select from four different display modes. When this setting step is selected six LEDs will illuminate in one of the four diagonal quadrants of the circle. We'll call these by their compass points NE, SE, SW and NW (northeast, southeast, etc.) since they don't properly align with a single number on the 12-hour clock face.

**NE.** The first (default) mode is the "native" mode of the Cyclochron. It uses the bidirectional chaser patterns to show time, where the emergence point is the minute and the convergence point is the hour.

**SE.** The second mode is identical to the first except that the two points for minute and hour are always illuminated. This actually occurs in the "native" mode (NE) as well when the two points are very close together. In this "Learning Mode" the two points are always on to make it just a little easier or more obvious what is happening. You may prefer this clue to be your normal display mode.

**SW.** This is a mixed mode display. It combines the "native" mode with the "Easy Reading" mode (described next). The two modes alternate every 10 or 15 seconds (depending on the DIP switch setting). In the Easy Reading period the seconds may be turned on or off by means of the DIP switch.

**NW.** The fourth mode is the Easy Reading mode, which eliminates the chaser and returns to a more traditional clock display. One single LED steps forward for every second, another single LED stays on steadily for the hour, and the minute is shown by three LEDs in a clockwise chaser pattern. The DIP switch does not affect the seconds in this mode; it is always shown.

Select the desired mode and press the SET button to exit from the setting cycles.

REVERSE button	<b>SET button</b>	ADVANCE button	Display indication
set AM or PM	1. Set AM or PM	set AM or PM	Three LEDs on morning or afternoon side of 12:00 indicate AM or PM
reverse hour	2. set hour	advance hour	One LED in one of the 12 hour-hand points around the circle.
reverse minute	3. set minute	advance minute	One LED in one of the 60 minute-hand points around the circle.
cycle through chime occurrence level: on the hour, every 30 minutes, every 15 minutes, silent	4. set chime occurrence level for each hour of the 24-hour daily cycle	advances through 24-hour cycle	Three LEDs on morning and afternoon side of noon for AM or PM hours show occurrence level by flashing or steady indications. Single LED at each of 12 points shows hour affected by setting.
step through four modes	5. set clock display mode	step through four modes	Six LEDs in four quadrants of display select the display mode. See the description of the modes.

## CLOCK TIMEBASE

The clock timekeeping is based on the local electrical power grid frequency, which is 60 Hertz (Hz) in North America and a few other isolated places, and 50 Hz most everywhere else. Generally the power generation authorities maintain long-term stability of this frequency, but it might go slightly up and down over a shorter time period, such as, for example, losing four seconds in the evening, but gaining them back by morning.

## READING THE TIME and CLOCK DISPLAY MODES

The four different display modes have been described briefly in the section on SETTINGS. Now they will be explained in greater detail.

The “native” or default mode is the dual chaser, which to our knowledge has never been used to indicate time using the analog clock metaphor. On-off patterns emerge from a point and travel outwards in two directions, and eventually come together or converge at another point. These unique points identify the position of the minute-hand and hour-hand on a standard analog clock face. Which one is the hour and which is the minute? A simple English mnemonic—based on the duality in meaning of “turn into” — is used: **minutes turn into hours**.

Thus the point where the motion emerges shows the minute-hand position and the point where the patterns converge shows the hour-hand point. Depending on the amount of activity and complexity of the patterns, these points may be easy or more difficult to see. This is even more difficult to see as the two points become very close. When the distance between them is three points or less, the two “hands” points turn on steadily. This makes it easier to see them. A second “Learning Mode” is provided where these two points are always on. Some people may prefer to keep the Cyclochron in the Learning Mode all of the time, but it does remove a bit of mystery and the opportunity to explain the secret to visitors.

Some additional special effects or variations of the chaser display will appear during certain minutes of a 30-minute cycle; this cycle repeats every 30 minutes. The following table shows the different visual effects.

minute	speed	effects...				
0	3	sweeper	flipper			sputer sputer
1	3	sweeper				
2	3	sweeper				
3	3					
4	1		flipper			
5	3	sweeper	flipper			scintillation scintillation
6	2	sweeper				
7	2	sweeper				
8	2					
9	1		flipper			
10	3	sweeper	flipper			sputer sputer
11	1	sweeper				
12	1	sweeper				
13	1					
14	1		flipper			
15	3	sweeper	flipper			scintillation scintillation
16	3	sweeper				
17	3	sweeper				
18	3					
19	1		flipper			
20	3	sweeper	flipper			sputer sputer
21	2	sweeper				
22	2	sweeper				
23	2					
24	1		flipper			
25	3	sweeper	flipper			scintillation scintillation
26	1	sweeper				
27	1	sweeper				
28	1					
29	1		flipper			

Sweeper cleans up the chaser display periodically, allowing complex patterns to be rebuilt. Flipper inverts the LED on-off sense every four seconds. Mobius inverts the entire pattern when it is fed back around the 60-stage shift register (usually only some of the 60 stages are visible). The scintillation effect uses two speeds, fast and slow, and rapidly alters (modulates) the intensity of the LEDs during the slower speed. And the spurter adds alternating start-and-stop to the chaser speed in effect. There are three chaser speeds, shown as 1, 2, and 3 in the above table.

An especially interesting event occurs 22 times each day, roughly every 65 minutes, when the minute hand approaches, overlaps and overtakes the hour hand point. Note that as the minute is approaching the hour point the predominant chaser motion is in the counterclockwise direction, and immediately after the minute hand has passed the hour hand point that the predominant chaser motion is in the clockwise direction. What happens when the two points are the same? The minute in which this occurs brings up a special programmed feature that slowly reduces the speed of the chaser motion until it comes to a momentary halt, and then reverses direction and speeds up again until it reaches the same starting speed as before. The overlap reversal occurs 30 seconds into the minute where the points coincide. (This is technically not exactly correct since 24 hours divided by 22 equals 65 minutes and 27.2727 seconds. But since the hour hand point can only be in one of 60 points, arrived at by rounding to the nearest whole point, these overlap events may be 65 or 66 minutes apart, based on truncation or rounding adjustments.)

An alternative display mode is provided, which can be called Easy Reading mode. In this mode there is no use of a complete circular chaser. Instead, the hour-hand position is shown by a steady LED, the second-hand position is shown by a single LED that steps forward one point per second and the minute position is shown by three LEDs that form a mini-chaser with ripple in one direction. The minute-hand position is thus featured or highlighted, because it is the most important one of the three. (Seconds are generally meaningless, and we can usually feel or know the current hour, but exactly where are we in the hour is usually of greatest importance: Do we have to leave for work now or in ten minutes? Do I have enough time to grab a bite to eat before my favourite TV program begins? How late is my spouse coming home from the office?)

There is also a mixed mode that combines the first "native" mode with the Easy Reading mode. Every ten or fifteen seconds the display switches between one and the other. In the mixed mode the step-wise seconds point may be shown or suppressed.

In the Easy Reading mode the speed of the three LED mini-chaser follows the program for the native mode chaser rate. Some of the special effects can also be seen on the three LEDs.

## **BATTERY BACKUP**

The Cyclochron has two CR2025 Lithium cells in snap-out holders that are accessible by removing the case. These only supply power during short-term power interruptions. When the power line drops out, the batteries take over timekeeping, but do not (and can not possibly) supply the requirement of around five watts to keep the LEDs going. After eight minutes of power interruption, the timekeeping functions will also cease (the microcomputer goes into a sleep mode to conserve power), but the display mode and chime occurrence levels programmed will be retained for a considerable time. Eight minutes should cover cases of brief dropouts from the electric power utility and possible popped circuit breakers due to overload or accidental shorts, providing enough time to turn the breaker back on. (A backup period longer than eight minutes would possibly unduly strain these small batteries, as they are running close to their published maximum current drain in the backup mode.)

When the power returns after the sleep time of eight minutes, the chime occurrence settings and display mode should be as they were set before, but this time will be wrong. It starts at 11:59:45, so fifteen seconds later the chime will sound (if it hasn't been silenced through the occurrence level setting for noon).

The coin cell batteries should not require replacement unless power outages are frequent. To access the batteries for replacement, remove the six screws on the rear of the unit, then carefully slip off the case.

## **REMOVAL OF BACK COVER**

The cover can be opened by removing six screws that face to the rear. The power connector is attached to the cover, and can be separated at the two pin connector. We recommend not removing the circuit boards unless absolutely necessary.

There are two types of cases. One, the original 1991 case, is formed from cold rolled steel and is either glued or soldered together. The other rear cover is a flange with a separate hoop that goes around the clock. In the case of the original case, care should be exercised in tightening the screws when replacing the cover. There is a gap between the cover and the brass standoff. If the screws are tightened too much it can force separation of the aluminum color subplate from the faceplate, which is attached with rubber contact cement or pressure-sensitive adhesives. Tighten the screws until they are just snug and about 1/2 turn tighter than when you first seem to feel them go under tension.

## INTERNAL ADJUSTMENTS

There are only two adjustment controls, plus a three-position DIP switch. These are accessible through holes on the rear cover. One potentiometer is for the chime tone frequency (the control adjusts the frequency of the lower note), and the second control adjusts volume of the chime. Pressing the REV and ADV buttons at the same time will cause an alternating two-tone warble to sound, which allows you to set the lower tone frequency. You may need an assistant to press the two buttons. Hint: a paper clip can be bent to go into both holes. The volume setting can be adjusted as required.

The DIP switches control some basic preference options as follows:

DIP Switch 1	ON = 50 Hz mains	OFF = 60 Hz power (North America)
DIP Switch 2	controls the mixed mode (number 3, shown by lower left LEDs in setting)	
	ON = 15 second period alternating between chaser and easy-reading display	
	OFF = 10 second period	
DIP Switch 3	ON = flashing seconds appear in mixed mode easy-reading display	
	OFF = seconds do not appear in the mixed mode easy-reading display	

## POWER SUPPLY

The Cyclochron requires an external power transformer to operate. It must supply at least 12 volts AC (not DC) at a minimum of 500 mA current. The transformer ("wallwart") is not supplied due to weight and access problems (we can't easily obtain small quantities of agency-approved wallwarts for each country where we are). A power adaptor for AC must be supplied and wired to the power connector. We strongly recommend obtaining a well made unit with approval marks (UL, CE, TUV, CSA, etc.) to ensure the greatest degree of safety.

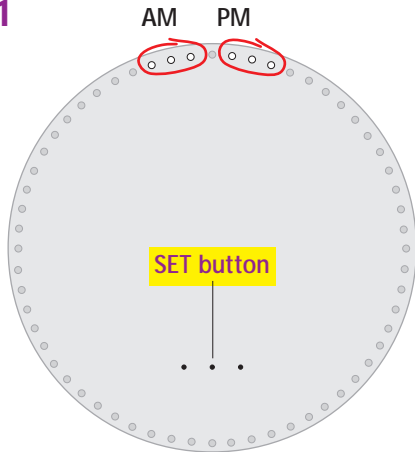
The power connector is a mini phone plug with power supplied to the tip and ring, but not to the sleeve, which connects to ground. Because the power supply internally uses a diode bridge and the output of that is grounded to reduce radiated noise, the AC power can not be connected to the ground (sleeve) on this connector.

If there is an impure tone (e.g., buzzing or chattering) when the chime sounds, it indicates that the power transformer is probably not able to supply enough current and that there is ripple present on the power to the chime tone oscillator. Try substituting a transformer wallwart with greater power output or slightly greater voltage. The maximum recommended voltage to apply is 15 VAC.

Two pages of schematics follow.

# Setting Time and Preferences

## Step 1



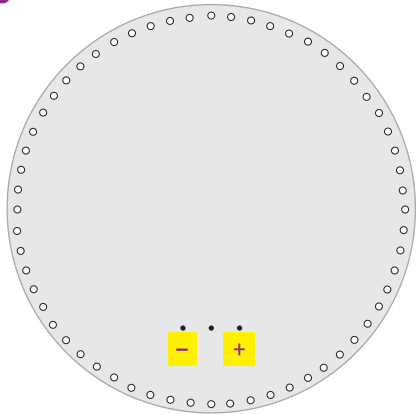
Three LEDs on either side of the 12 o'clock position indicate AM or PM (hours 0–11 or 12–23). This information is used internally for chime tone suppression, if desired.

The setting process has five steps. The middle SET button is used to step from one to the next. After the last step the clock will return to the time display. The settings can be entered at any time with the SET button.

In these diagrams, the white circles indicate which LEDs are used for that setting step.

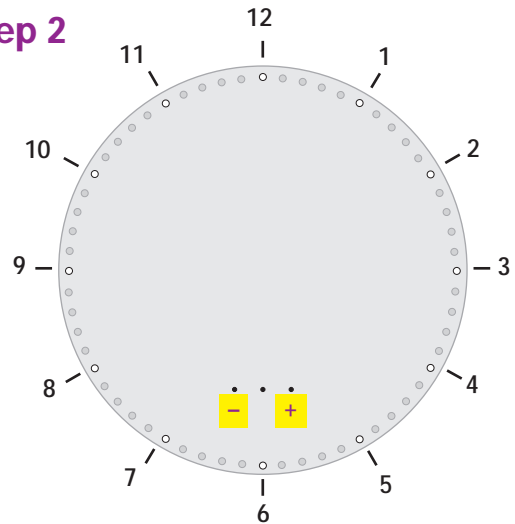
Pressing the left and right buttons at the same time when the clock display is running will produce an alternating test tone, which allows setting volume and lower pitch via screwdriver settings on the rear.

## Step 3



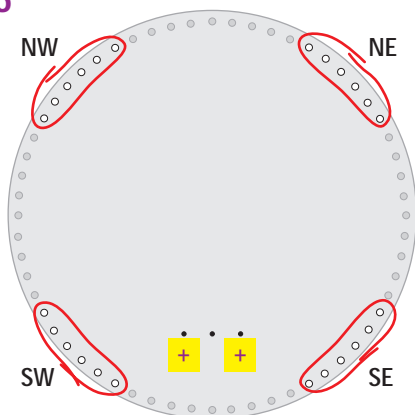
Minutes Setting. The minutes are shown on one of the 60 points corresponding to the minute. ADV steps forward, REV steps backwards.

## Step 2



Hours Setting. The hour is shown on one of the 12 points corresponding to the hour. ADV steps forward, REV steps backwards.

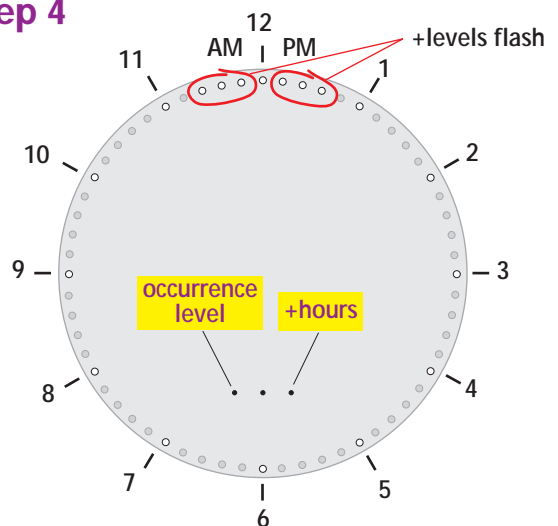
## Step 5



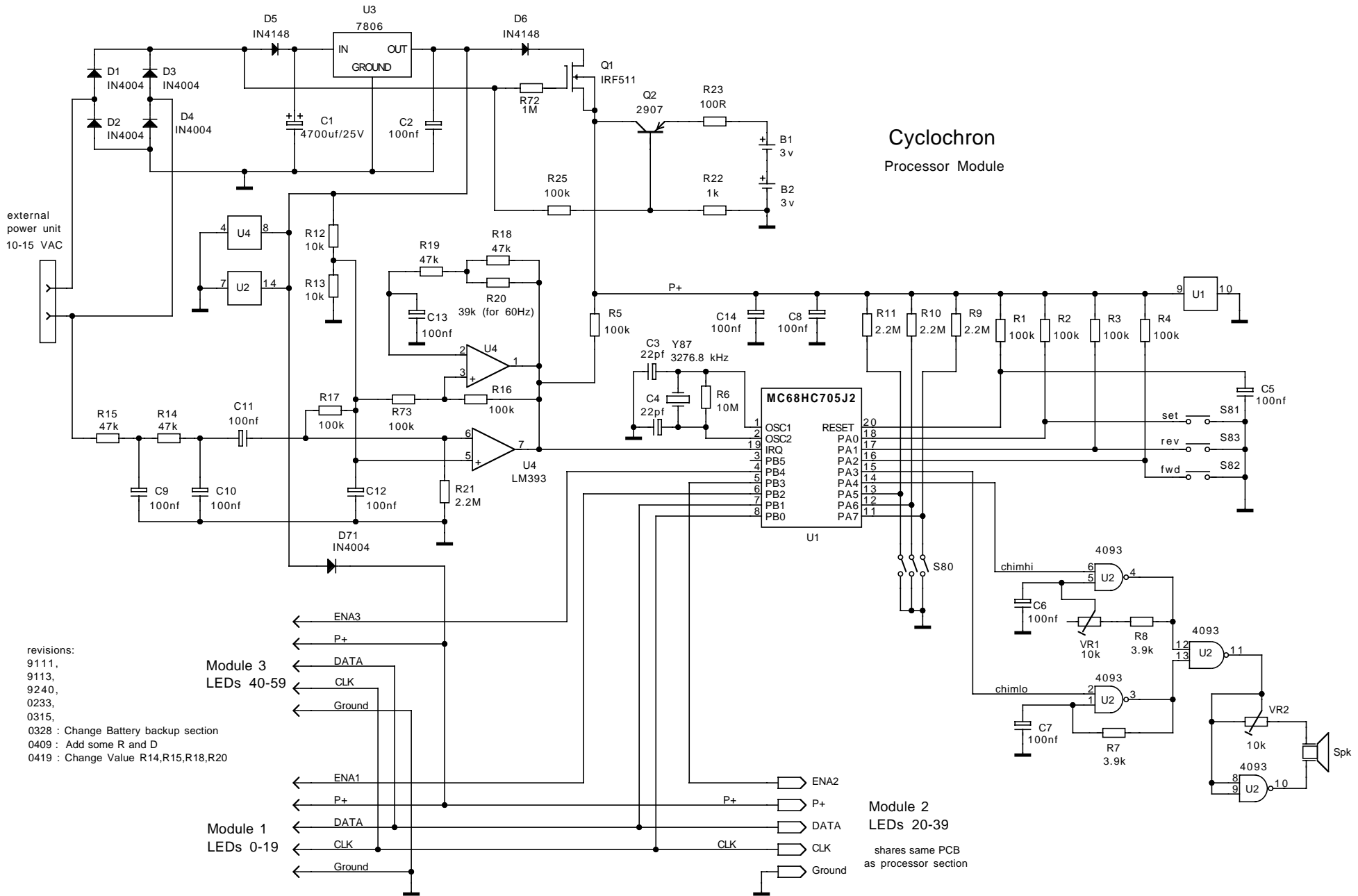
Display Mode Preference. Six LEDs in the four corners indicate which of four display modes are selected.

- NE – Native chaser mode.
- SE – Learning Mode, chaser + helper LEDs at hour & minute.
- SW – Native mode alternating with Easy Read mode.
- NW – Easy Reading, hour, minute & second points shown.

## Step 4



Chime Occurrence Level. Determines how often the chime sounds during each of the 24 hours in a day. The 12 hour points in combination with the AM/PM indicator indicate the hour. The number of times that the chime sounds in that hour is flashed on the AM or PM indicators (no flash means not sounding in that hour). ADV steps through 24 hours, REV steps through the levels of occurrence.



# Cyclochron Processor Module

revisions:  
 9111,  
 9113,  
 9240,  
 0233,  
 0315,  
 0328 : Change Battery backup section  
 0409 : Add some R and D  
 0419 : Change Value R14,R15,R18,R20

Module 3  
LEDs 40-59

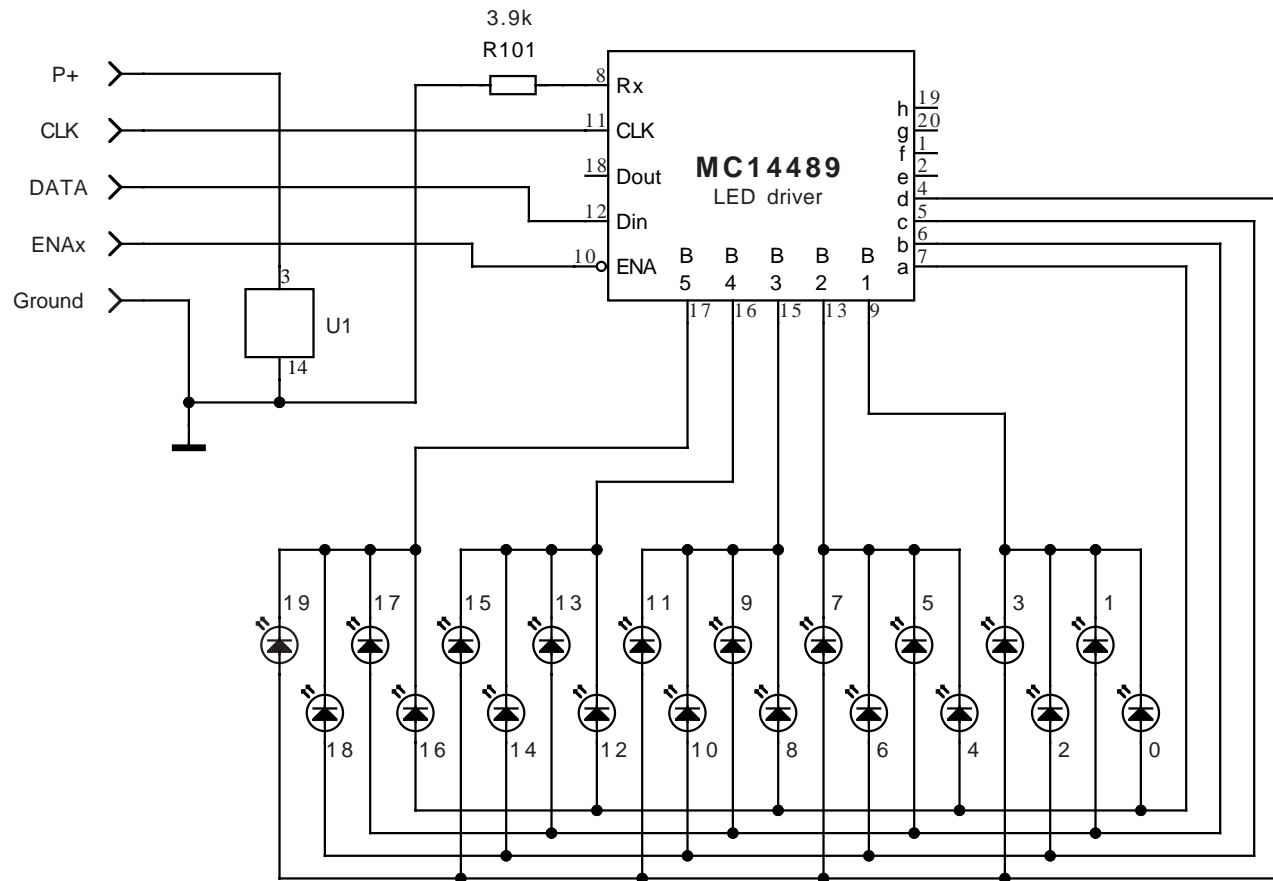
Module 1  
LEDs 0-19

Module 2  
LEDs 20-39

shares same PCB  
as processor section

# CycloChron

120° Arc Segment Display



"0" is LED 0 or 20 or 40  
 "19" is LED 19 or 39 or 59