AP21

OPERATION/SERVICE MANUAL

For Version 3.02 and higher.

RTC Manufacturing, Inc.

AP21

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INTRODUCTION

The AP21 is an single circuit, calendar-programmable solid state time switch used for switching electric circuits according to pre-set time and date program. The AP21 is primarily designed for school zone and traffic control use where multiple daily/weekly programs are required on an annual basis. The relay output can be programmed for momentary operation for bell or buzzer operation in schools, churches, or industrial facilities.

ELECTRICAL SPECIFICATIONS

Power Requirements:	· 95VAC to 135VAC, 60HZ., 3 VA maximum 10.5VDC to 14.3VDC less than 1 watt through full range of supply voltage (0.2 to 0.58 average)
Outputs:	· AP21, SPDT relay rated at 15 AMP resistive at 120VAC
Wiring:	· Terminal block can accommodate #12 to #24 AWG wire

PHYSICAL SPECIFICATIONS

Dimensions:	· 3.7"W x 8.0"H x 1.55"D
Weight:	· Approximately 2 pounds
Mounting:	· Pre-drilled mounting hole (AP21)
Operating Temperature:	·-30˚ to +74˚C

PROGRAMMING FEATURES

AUTO PROMPTING DISPLAY — The display provides information to guide the operator through programming. Upon power-up, it will prompt the operator through setting the time and basic programming sequence.

DAY PLAN — The Day Plan is made up of the programmed steps that will take place on the assigned days and control the output relay. The Day Plan can be assigned to all days, just week days, just weekends, or specific days of the week.

16 PROGRAM STEPS — The Day Plan can hold up to 16 program steps. The 16 program steps are used to program ON/OFF times for the relay.

ANNUAL "SKIP" PLAN — The AP21 can hold up to 10 Annual "Skip" Plans, which are dates or date ranges that will receive no programming steps. Annual plans are used for special events such as holidays or spring break, throughout the calendar that differ from "normal" Day Plan scheduling.

PROGRAMMABLE DAYLIGHT SAVING TIME ADJUSTMENT — The AP21 automatically adjusts for daylight saving time changes according to U.S. law. Re-programmable if law changes.

AUTOMATIC LEAP YEAR COMPENSATION — Perpetual type calendar to adjust for the extra day every 4 years.

TRANSFER — Allows program data to be transferred from one AP21 to another or from a computer to an AP21.

MANUAL OVERRIDE — The output relay can be manually activated or deactivated from the keyboard. The manual override will remain in effect until the next programmed step occurs.

SLEEP MODE — Deactivates relay output while maintaining all timing data during summer vacation.

PULSE OUTPUT — The output can be programmed to operate as constant contact or a momentary contact programmable from 1 to 99 seconds.

POWER FAIL BACKUP

Program and time keeping is maintained for 48 hours on a rechargeable capacitive backup system in the event of a power failure. The output and display are disabled during backup. The AP21 resumes normal operation when power is restored.

ACCURACY

TIME KEEPING — Synchronous with the AC power line and 4 PPM on DC power. During a power failure it is quartz crystal controlled with an accuracy of +/-.005% throughout its full temperature range.

PROGRAMMED EVENTS — On/Off events are programmable with a one minute resolution and occur at the zero second of that minute.

WIRING

WARNING: Disconnect power before wiring connection. Observe all safety precautions.

AP21 TERMINAL BLOCK

AC−	AC+	GND	+12V	−12V	N/O	N/C	COM
					Relay N/O (OUT)		Relay Moveable (IN)

TXDOT WIRING AP21/CPR

PIN #	WIRE COLOR	FUNCTION
1	Black	120 VAC
2	White	AC - (Neutral)
3	Green	Chassis Ground
4	Red	Relay N/O
5	Yellow	Relay N/O
6	N/U	N/U
7	N/U	N/U
8	N/U	N/U
9	N/U	N/U
10	White/Yellow	Relay Common
11	White/Red	12V DC+
12	White/Black	12V DC Common
13	N/U	N/U
14	N/U	N/U
15	N/U	N/U
16	N/U	N/U

STANDARD WIRING AP21/CPR

PIN #	WIRE COLOR	FUNCTION
1	Black/White	120 VAC
2	White	AC - (Neutral)
3	Green	Chassis Ground
4	Yellow/Black	Relay Common
5	Yellow	Relay N/C
6	N/U	N/U
7	N/U	N/U
8	N/U	N/U
9	N/U	N/U
10	Yellow/White	Relay N/O
11	N/U	N/U
12	N/U	N/U
13	Black/Red	12V DC−
14	N/U	N/U
15	Red	12V DC+
16	N/U	N/U

AP21TR OCTAL BASE MOUNT PIN OUT *(discontinued product, unavailable for a new installation)*

To install the AP21TR requires an eight-pin octal base such as a Potter and Brumfield #27E122 or equivalent. Mount this base in a suitable location and wire the terminals of the base as follows:

AC VERSION
1. Relay Common
2. Line
3. Relay normally open
4. Relay normally closed
5.
6.
7. Neutral
8.

DC VERSION
1. Relay Common
2.
3. Relay normally open
4. Relay normally closed
5.
6. −12VDC
7.
8. +12VDC

DISPLAY AND KEYBOARD DESCRIPTIONS

ALPHA-NUMERIC DISPLAY – Used for displaying time, day, date, output status and for displaying information during programming or reviewing stored programs.

KEYBOARD – Many of the AP21 keys serve multiple functions. Those keys are clearly labeled with their functions printed adjacent to the key. They cannot be used incorrectly as the display will AUTO PROMPT the user as to which key to press.

AM/ON (1) KEY – Used for setting time to AM when in the time set or programming modes. Also used for setting output to ON or OFF when in the programming mode. Also used for setting the output to ON manually.

PM (2) KEY – Used for setting the time to PM when in the time set or programming modes.

TIME (3) KEY – Used for entering the set time mode.

ANNUAL (A) KEY – Used for entering the annual programming mode and for stepping through the stored annual programs for review. The annual programs contain the skip plans in calendar schedule form.

BASIC (B) KEY – Used for entering the basic programming mode and for stepping through the stored basic programs for review. The basic programs contain the daily timed events instructions.

CLEAR (C) KEY – Used for clearing all annual skip plans and basic program steps.

DATE (D) KEY – Used for entering the set date mode for entering date or reviewing the date.

EXIT (#) KEY – Used for exiting the set time, set date, or program mode.

OFF (0) KEY – Used for setting the output to OFF when in the programming mode. Also used for setting the output to OFF manually.

STEP/ENTER (*) KEY – Used for entering all commands and for stepping through the set time, set date or program data entry.

DST (7) KEY – Used for entering or changing the daylight savings time program.

DAY (4) KEY – Used for setting the current day of the week.

PULSE (5) KEY – Used for programming the output relay on for a specific time period (bells, sirens, etc.).
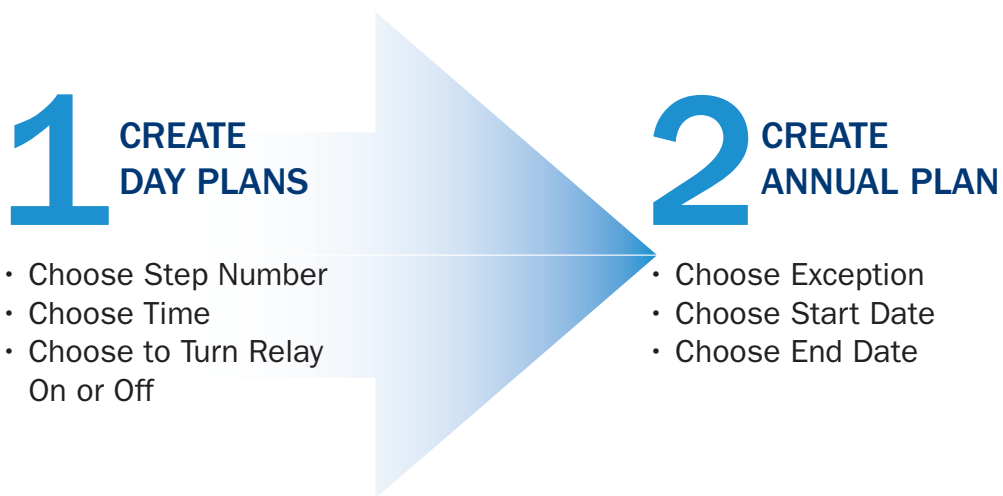
PROGRAMMING INSTRUCTIONS

THE AP21 CURSOR — On many of the AP21 display screens you will see a flashing square character called the cursor. The cursor indicates that you may now enter or change the data at that position of the display.

AUTO PROMPT DISPLAY — On a cold start with a discharged back-up capacitor, the AP21 will automatically prompt the operator through the programming procedure. The operator simply has to follow the display and enter the appropriate data as the cursor advances through the program entries. You may exit this sequence if desired by pressing the EXIT (#) key and the unit will default to the time display mode. From the time display mode, you may enter any of the set time, date, or program modes manually.

ENTERING DATA — From the cursor, you enter the appropriate data and press the **ENTER** (✱) key. The cursor will automatically advance to the next position. If the data at the cursor is correct, simply press the **ENTER** (✱) key to advance the cursor. The AP21 will not allow you to enter an invalid number (i.e., the unit will not accept the number 13 for a month entry). The cursor will remain in its position until a valid entry is made, so keep pressing the keys until you see the correct number at the cursor and then press the **ENTER** (✱) key.

PROGRAMMING SEQUENCE

1 CREATE DAY PLANS

· Choose Step Number
· Choose Time
· Choose to Turn Relay On or Off

2 CREATE ANNUAL PLAN

· Choose Exception
· Choose Start Date
· Choose End Date

DISPLAY KEY CODES

∗ = ENTER

WDY = Mon thru Fri

MM = month of the year

EDY = every day of the week

DD = day of the month

WND = Sat and Sun only

YY = year

HH = hour of the day

MM = minute of the hour

SUN = the Sunday of the month for DST change

1 = first Sunday   **4** = fourth Sunday

2 = second Sunday   **L** = last Sunday

3 = third Sunday

SPECIAL FUNCTION CODES

0 = Manual operation is set to OFF

1 = Manual operation is set to ON

7 = DST (daylight saving time change)

45 = Sleep Mode (disables output relay)

77 = Clear all data for reprogramming

78 = Program transfer between AP21 units

99 = Current software version

88 = Prevents the screen from blanking

88 = again allows the screen to blank

HH : MM

— *when Colon is Flashing = Display Blanking*

— *when Colon is Steady = Display "ON" continuously*

TIME SWITCH KEYS

1 = AM and ON

2 = PM

3 = TIME (time-of-day)

4 = DAY (day-of-week)

5 = PULSE (pulse or steady output/s)

7 = DST (Daylight Saving Time)

0 = OFF (relay off)

A = ANNUAL (programs)

B = BASIC (programs)

C = CLEAR (clear all annual or basic programs)

D = DATE (month, day, year)

= EXIT (exit to the time display mode)

∗ = ENTER (enter the data at the cursor)

AP21 QUICK REFERENCE PROGRAM GUIDE

NOTE: The display of the AP21 will automatically blank after about 5 minutes of keyboard inactivity, simply press any key to reactivate the display.

Start programming from the **MAIN DISPLAY**.

PROGRAM THE TIME-OF-DAY

— From the **MAIN DISPLAY**, press key **3** (**TIME**) then **ENTER** (✶).
Enter the time-of-day as iillustrated at right:

$$H H \; * \; M M \; * \; A M / P M \; *$$

Note: ✶ = ENTER

> To Review Or Change The Time-Of-Day

From the **Time Display Mode**:

· Press **TIME (#3)** and then press **ENTER** (✶), the cursor will be at the HOUR position

· Press **ENTER** (✶) if the HOUR displayed is correct, or key in the correct HOUR and press **ENTER** (✶), the cursor will now advance to the MINUTE position

· Press **ENTER** (✶) if the MINUTE displayed is correct, or key in the correct MINUTE and press **ENTER** (✶), the cursor will advance to the AM/PM position

· Press **ENTER** (✶) if the AM/PM displayed is correct, or key in the correct AM/PM and press **ENTER** (✶), the new time will begin and the display will return to the **Time Display Mode**

PROGRAM THE DATE

— From the **MAIN DISPLAY**, press **D (DATE)** then **ENTER (∗)**.
Enter the date as iillustrated at right:

```
M M  ∗  D D  ∗  Y Y  ∗
```

Note: ∗ = ENTER

> To Review Or Change The Date

From the **Time Display Mode**:

· Press **DATE (D)** and then press **ENTER (∗)**, the cursor will be at the MONTH position

· Press **ENTER (∗)** if the MONTH displayed is correct, or key in the correct MONTH and press **ENTER (∗)**,
the cursor will now advance to the DAY position

· Press **ENTER (∗)** if the DAY displayed is correct, or key in the correct DAY and press **ENTER (∗)**,
the cursor will advance to the YEAR position

· Press **ENTER (∗)** if the YEAR displayed is correct, or key in the correct YEAR and press **ENTER (∗)**,
the display will return to the **Time Display Mode**

PROGRAM THE DAY-OF-WEEK

— From the **MAIN DISPLAY**, press **4** (DAY) then **ENTER (∗)**.
Enter the day-of-week as iillustrated at right:

Note: Press key **4** (**DAY**) until the correct day appears.

```
D a y - o f - w e e k  ∗
```

Note: ∗ = ENTER

> To Review Or Change The Day-Of-Week

From the **Time Display Mode**:

· Press **DAY (#4)** and then press **ENTER (∗)**, the cursor will be at the MONTH position

· Press **ENTER (∗)** if the DAY OF THE WEEK displayed is correct, or advance to the correct DAY OF THE WEEK by
pressing **DAY (#4)** repeatedly until the correct DAY OF THE WEEK is displayed, and then press **ENTER (∗)**,
the display will return to the **Time Display Mode**

PROGRAM DAYLIGHT SAVING TIME (DST)

— From the **MAIN DISPLAY**, press key **7** (**DST**) then **ENTER** (✱).
Enter the spring and fall Daylight Saving Time as iillustrated
at right:

Note: The AP21 will default to the current U.S. standards:

S (Spring), **M** = **03** (March), SUN = **2** (second Sunday)

F (Spring), **M** = **11** (November), SUN = **1** (first Sunday)

To change the month, simply key in the new month and press **ENTER** (✱).

To change to another Sunday of the month, key in the Sunday of the
desired month by entering:

1   first Sunday
2   second Sunday
3   third Sunday
4   fourth Sunday
5   last Sunday

Then press **ENTER** (✱).

To **disable** DST, enter the Spring month as **0.**

```
S DST: MM ✱ SUN ✱
F DST: MM ✱ SUN ✱
```
Note: ✱ = ENTER

> To Review Or Change Daylight Saving Time

From the **Time Display Mode**:
· Press **DST (#7)** and then press **ENTER** (✱)

SPRING DST will appear on the display

· Press **ENTER** (✱) if the MONTH displayed is correct, or key in the correct MONTH and press **ENTER** (✱),
the cursor will advance to the SUNDAY position

*NOTE: To bypass the DST feature, enter 00 and press **ENTER** (✱)*

· Press **ENTER** (✱) if the SUNDAY displayed is correct, or key in the correct SUNDAY and press **ENTER** (✱)

FALL DST will appear on the display

· Press **ENTER** (✱) if the MONTH displayed is correct, or key in the correct MONTH and press **ENTER** (✱),
the cursor will advance to the SUNDAY position

· Press **ENTER** (✱) if the SUNDAY displayed is correct, or key in the correct SUNDAY and press **ENTER** (✱),
the display will return to the **Time Display Mode**

BASIC PROGRAM STEPS

— From the **MAIN DISPLAY**, press **B** (**BASIC**) then **ENTER** (✶).
Enter the step number, press **ENTER** (✶), and enter the program step information as illustrated below:

> **D a y / s ✶ H H ✶ M M ✶ A M / P M ✶ O N / O F F ✶**

Note: ✶ = ENTER

> To Enter Or Change The Basic Program Steps

From the **Time Display Mode**:

· Press **BASIC (B)** and then press **ENTER** (✶)

· Key in specific program step number (00-16) or press **ENTER** (✶) to move one by one

· Press **ENTER** (✶) if the day/s displayed is correct or, advance to the correct day/s by pressing **DAY (#4)**,
then press **ENTER** (✶), the cursor will advance to the HOUR position

· Press **ENTER** (✶) if the hour displayed is correct or, key in the correct hour then press **ENTER** (✶), the cursor will
advance to the AM/PM position

· Press **ENTER** (✶) if the AM/PM displayed is correct or, key in the correct AM/PM then press **ENTER** (✶), the display
will advance to the ON/OFF position

· Press **ENTER** (✶) if the ON/OFF displayed is correct or, toggle the ON or OFF then press **ENTER** (✶), the cursor will
advance to the next program step number

· Repeat the programming process or press **EXIT (#)** to return to the **Time Display Mode**

> To Review The Basic Program Steps

From the **Time Display Mode**:

· Press **BASIC (B)** and then press **ENTER** (✶)

· Press **BASIC (B)** to advance through the BASIC program steps

· Press **EXIT (#)** to escape to the **Time Display Mode**

> To Clear A Basic Program Step

From the **Time Display Mode**:

· Press **BASIC (B)** and then press **ENTER** (✶)

· Key in the step number to be cleared then press **ENTER** (✶)

· Press **ENTER** (✶) to advance the cursor to the HOUR

· Key in 00 (zero, zero) for the HOUR then press **ENTER** (✶), the program step is cleared and the display
returns to STEP 00

· Key in another step number to be cleared or press **EXIT (#)** to return to the **Time Display Mode**

> Clearing All Basic Programming

From the **Time Display Mode**:

· Press **CLEAR (C)**, then **ENTER (✴)**

· Press **BASIC (B)** to clear all of the Basic programming

· Press **EXIT (#)** to escape to the **Time Display Mode**

ANNUAL PLAN PROGRAMMING

— Press the **ANNUAL (A)** key and press **ENTER (✴)**, key in the number, press **ENTER (✴)**, and enter the annual plan program as as iillustrated at right, be sure to press **ENTER (✴)** after each entry.

Note: To skip a single day, both the START date and END date must be the same.

```
S T A R T :  M M  ✴  D D  ✴  Y Y  ✴
    E N D :  M M  ✴  D D  ✴  Y Y  ✴
```

Note: ✴ = ENTER

> To Enter Or Change The Annual Plan Program Steps

Starting from the **Time Display Mode**:

· Press **ANNUAL (A)** and then press **ENTER (✴)**

· Key in specific PLAN number to be changed, then press **ENTER (✴)**, the START date (MM-DD-YY) will be displayed

· Press **ENTER (✴)** if the month displayed is correct or, key in the correct month then press **ENTER (✴)**, the cursor will advance to the DAY position

· Press **ENTER (✴)** if the day displayed is correct or, key in the correct day then press the **ENTER (✴)**, the cursor will advance to the YEAR position

· Press **ENTER (✴)** if the year displayed is correct or, key in the correct year then press the **ENTER (✴)**, the display will advance to the END date (MM-DD-YY)

· Press **ENTER (✴)** if the month displayed is correct or, key in the correct month then press **ENTER (✴)**, the cursor will advance to the DAY position

· Press **ENTER (✴)** if the day displayed is correct or, key in the correct day then press **ENTER (✴)**, the cursor will advance to the YEAR position

· Press **ENTER (✴)** if the year displayed is correct or, key in the correct year then press **ENTER (✴)**, the display will advance to the next ANNUAL plan number

· Repeat the programming process or press **EXIT (#)** to return to the **Time Display Mode**

> To Review Annual Plan Program Steps

Starting from the **Time Display Mode**:

- · Press **ANNUAL (A)** and then press **ENTER (✳)**
- · Press **ANNUAL (A)** to advance through the ANNUAL PLAN program steps
- · Press **EXIT (#)** to escape to the **Time Display Mode**

> To Clear All Annual Plan Programs

Starting from the **Time Display Mode**:

- · Press **CLEAR (C)** and then press **ENTER (✳)**
- · Press **ANNUAL (A)** key to clear all ANNUAL PLAN programs
- · The display will return to the **Time Display Mode**

> To Clear A Specific Annual Plan Program

Starting from the **Time Display Mode**:

- · Press **ANNUAL (A)** and then press **ENTER (✳)**
- · Key in specific ANNUAL PLAN number to be cleared, then press **ENTER (✳)**
- · Key in **00** (zero, zero) for the month then press **ENTER (✳)**, the ANNUAL PLAN is cleared and the display returns to 00
- · Key in another ANNUAL PLAN number to be cleared or press **EXIT (#)** to return to the **Time Display Mode**

ACTIVATE SLEEP MODE

Starting from the **Time Display Mode:**

· Key in **45** and then press **ENTER** (✱), SLEEP MODE will be displayed

DEACTIVATE SLEEP MODE

Starting from the **Sleep Display Mode:**

· Key in **45** and then press **ENTER** (✱), SLEEP MODE is no longer on or visible on the display

· Press the **EXIT (#)** key to return to the **Time Display Mode**

ENTER OR CHANGE THE PULSE RATE (BELLS, SIRENS, ETC.)

Starting from the **Time Display Mode:**

· Press **5** and then press **ENTER** (✱)

· Press **ENTER** (✱) if the pulse displayed is correct or, key in the correct PULSE (0 = steady ON, 01 to 99 = steady ON for X seconds) then press **ENTER** (✱)

· The display will return to the **Time Display Mode**

MANUALLY OPERATE THE OUTPUT RELAY

Starting from the **Time Display Mode:**

ON: To manually turn the AP21 RELAY ON, press **1**, then **ENTER** (✱), the display will return to the **Time Display Mode**

OFF: To manually turn the AP21 RELAY OFF, press **0**, then **ENTER** (✱), the display will return to the **Time Display Mode**

DISPLAY SECONDS IN THE TIME DISPLAY

Starting from the **Time Display Mode:**

· Key in **33** and then press **ENTER** (✱), the SECONDS display will appear

· Press **EXIT (#)**, the display will return to the **Time Display Mode**

TRANSFER A PROGRAM FROM ONE AP21 TO ANOTHER

Starting from the **Time Display Mode:**

· Key in **78**, then press **ENTER** (✱) on the AP21 the program will be transferred FROM

· Connect an RTC time-switch-to-time-switch transfer cable (not included) to the two time switches and press **ENTER** (✱) on the AP21 the program will be transferred FROM

· The program will be transferred from one AP21 to the other

· The display will return to the **Time Display Mode**

LIMITED PRODUCT WARRANTY

RTC | **RTC Manufacturing, Inc.**
RTC-TRAFFIC.COM

RTC Manufacturing, Inc. (RTC) warrants its products to be free from defects in materials and workmanship for a period of five (5) years from the date of purchase provided:

- **the product was properly installed, used, operated and maintained;** *and*

- **the customer has proof of the date of purchase**

RTC will, at its option, either repair or replace the defective product.

The customer at its cost shall deliver the defective product to RTC, and RTC will repair or replace the product and return it to the customer at RTC's cost.

RTC will not be responsible for damage caused by electrical surges, brownouts, blackouts, lightning or any other act of God or electrical event.

PRODUCT EXCEPTIONS:

— Cellular Modem equipment carries the same warranty above, except the term is for a period of two (2) years. Extended modem warranties are available for purchase.

— Radio Equipment carries the same warranty above, except the term is for a period of one (1) year.

— Batteries carry the same warranty above, except the term is for a period of two (2) years.

RTC | RTC Manufacturing, Inc.

SERVICE

It is recommended that all service for the AP21 be performed by the factory or by a factory-authorized service representative.

CAUTION: If you repair your AP21 time switches without factory support, please note that before removing or replacing any IC1 or IC2, the 1 FD super capacitor must be totally discharged to avoid damage. On the left side of the printed circuit assembly, there are two test points. One is ground and the other is the super capacitor connection. Use a clip lead to short these test points together to discharge the super capacitor. It is recommended that the clip lead be left in place until the repair is completed.

RTC Manufacturing, Inc. is committed to provide ongoing service support for time switches in or out of warranty. Please ship your repairs freight prepaid to the dealer in your area, or directly to:

> RTC Manufacturing, Inc.
> 1016 Enterprise Place
> Arlington, Texas 76001

If the customer/end user ships directly to RTC, shipping charges will be paid by RTC for repaired products returned to the customer/end user via regular surface freight. Overnight delivery must be requested in advance and will be billed to the customer/end user.

THEORY OF OPERATION

The AP21 is a microprocessor based device. Because of the large scale integrated circuits used, there are only three (3) ICs that make up the time switch.

IC1 is a 6805 type microprocessor with built-in RAM and ROM. The built-in RAM is used for storing the time, date and program information. The built-in ROM contains the AP21 operating software (approximately 4kb). The software of the AP21 time switch is copyrighted. Reproductions of any kind are strictly prohibited by law.

IC2 is the real time clock. This circuitry is used only during power failures to keep time until power returns.

Schematics and Parts List are available directly by request by contacting RTC.