

Operating Manual DIY Alarm Clock with FM radio

This DIY Alarm Clock is using the housing and the hardware of a Philips AJ3400 Alarm Clock. The main features are:

- Setting and showing the time
- FM radio with preset functionality
- Two alarm times
- Giving an alarm using a beep signal or the sound of an FM radio station
- Snooze timer
- Sleep timer
- Volume control
- Display brightness control
- Store all user settings in non-volatile memory
- Battery backup

When the clock is powered on, the time will be shown and the decimal point of the hour 10 segment will blink. If the display was previously turned off, it will be turned on for a few seconds.

Setting the clock time

There must be no alarm active to set the time. Steps to be taken:

1. Press the 'Preset' key for 2 seconds. The display starts blinking and shows the current time.
2. Pressing the 'Hour/Tune up' key will move the hour 1 step forward. Repeat until the hour is correct.
3. Pressing the 'Minute/Tune down' key will move the minute 1 step forward. Repeat until the minute is correct.
4. Press the 'Preset' key. The display will stop blinking and the time is set.

Setting the alarm time

This works the same for alarm 1 and alarm 2. There must be no alarm active and the radio must be off. Steps to be taken using alarm 1 as example:

1. Press the 'AL1/Volume -' key for 2 seconds. The display starts blinking and shows the currently set alarm time. Both alarm 1 indicators (radio or alarm) will blink.
2. Pressing the 'Hour/Tune up' key will move the hour 1 step forward. Repeat until the hour is correct.
3. Pressing the 'Minute/Tune down' key will move the minute 1 step forward. Repeat until the minute is correct.
4. Press the 'AL1/Volume -' key. The display and the alarm indicators will stop blinking and the alarm time is set.

Setting the radio presets

Ten FM radio presets can be stored.

Steps to be taken:

1. Press the 'Radio' key for 2 seconds. The display starts blinking and shows the currently set radio frequency in MHz. The decimal point of the minutes 10 segment will blink.
2. Pressing the 'Hour/Tune up' key will tune to the next FM radio channel.
3. Pressing the 'Minute/Tune down' key will tune to the previous FM radio channel.
4. To store the found FM radio channel press the 'Preset' key for 2 seconds. The display starts blinking and shows the current preset number.
5. Pressing the 'Hour/Tune up' key increment the preset number.
6. Pressing the 'Minute/Tune down' key will decrement the preset number.
7. When the preset number is correct, press 'Preset'. The selected FM radio channel will be stored with the currently selected preset.
8. Repeat from step 2 to find and store additional FM radio channels.
9. Press the 'Radio' key. The display and the frequency indicator will stop blinking. The display will show the time again,

Note that during this process the volume can be changed by using the 'AL1/Volume -' and 'AL2/Volume +' keys.

Setting an alarm

This works the same for alarm 1 and alarm 2. There must be no alarm active and the radio must be off. Steps to be taken using alarm 1 as example:

1. Press the 'AL1/Volume -' key. The FM radio alarm will be activated.
2. Press the 'AL1/Volume -' key again. The beep alarm will be activated.
3. Press the 'AL1/Volume -' key. The alarm will be off.

The selected alarm type is indicated by the Alarm Radio LED or Alarm Beep LED. When an alarm is activated the alarm time is displayed for a few seconds.

Setting the volume

The volume can only be set if the FM radio is on or when the alarm is on. The set volume is used for the FM radio and the alarm. Steps to be taken:

1. Press the 'AL1/Volume -' key. The volume will decrement one step. This can be repeated until the volume level is 1.
2. Press the 'AL2/Volume +' key. The volume will increment one step. This can be repeated until the volume level is 15 which is the maximum.

Switching off an active alarm

When an alarm is activated, the FM radio or the beep signal will be heard. The alarm starts with a low volume and will increase to the level of the set volume. The alarm indicator of the active alarm will blink.

There are two ways to switch off an active alarm:

1. Press the 'Snooze' key. The alarm will stop but it will stay active and will repeat again after 7 minutes. The alarm indicator of the active alarm will keep on blinking.
2. Press the 'Preset' key. The alarm will stop and will be switched off. The alarm indicator of the active alarm will stop blinking but stays on. After 24 hours the alarm will be activated again.

Switching the radio on or off

Steps to be taken:

1. When the radio is off, press the 'Radio' key. This will turn the radio on.
2. When the radio is on, press the 'Radio' key. This will turn the radio off.

When the radio is on, the volume of the alarm clock can be changed by the 'AL1/Volume -' key and 'AL2/Volume +' key.

In all cases where the radio is turned on, the decimal point of the minutes 10 segment will be active.

Changing the radio preset

This can only be done if no alarm is active and when the radio is on. Steps to be taken:

1. Press the 'Preset' key. The display will show the next preset and the next FM radio channel is selected.
2. Repeat step 1) to select the next preset. When the maximum preset number 10 is reached, the preset number starts at 1 again.

Using the sleep timer

This can only be used when no alarm is active otherwise the 'Snooze' key will just snooze the alarm. There is another special situation where this key is not used as sleep timer and that is when the display is turned off. In the case where the display is turned off, the 'Snooze' key will turn the display on for a few seconds. If no alarm is active and the display is turned on the sleep timer functionality can be used. Steps to be taken:

1. Press the 'Snooze' key. The FM radio is turned on and the snooze timer is set to 15 minutes. The snooze time is shown on the display.
2. When repeating step 1), the snooze time will change as follows: 30 minutes -> 60 minutes -> 90 minutes -> OFF. The set snooze time will be displayed.

After the snooze time has passed, the FM radio is turned off.

Changing the brightness of the display

The brightness of the display can be changed in 4 steps. Next to that the display can also be switched off completely. Steps to be taken:

1. Press the 'Brightness' key. The brightness of the display will decrease. After the minimum brightness is reached, the display will be turned off completely.
2. When the display is turned off and step 1) is done again, the display will return to maximum brightness.

Note that when the display is off and an alarm is activated, the display will be turned on with minimum brightness until the alarm is deactivated, after which the display will be turned off again.

Keep in mind that changing any settings, like activating an alarm or setting the time will still work when the display is turned off so make sure that the display is turned on before changing any settings.

Information when developing the software

When developing the software, a programmer will be connected to the alarm clock. This programmer uses 2 pins B7 and B6 of the PIC to which the keyboard is connected. During development these pins cannot be used. These key that cannot be used are:

- AL1/Volume '-' key
- 'Brightness' key

In the software a constant USING_PROGRAMMER can be set. This setting will prevent the usage of these 2 keyboard pins. When the final software version is complete, this setting must be removed and the program needs to be recompiled before programming the PIC with the final version.

As a consequence of the setting USING_PROGRAMMER some keys behave differently. Changes are as follows:

- In normal mode, the 'Hour/Tune up' key now used to set Alarm 1 on or off.
- When the Alarm 1 time is being programmed, the exit of the Alarm is normally 'AL1/Volume -' but in this case is not the 'Hour/Tune up' (like above) but the 'Snooze' key. This because the 'Hour/Tune up' is now used to set the hour of Alarm time 1.
- In normal mode, the 'Minute/Tune down' key is used as brightness key.