
Si4840/44 DEMO BOARD USER'S GUIDE

1. Features

- ATDD (analog tune and digital display) FM/AM/SW radio
- Worldwide FM band support from 64 to 109 MHz with 5 default sub-bands:
 - FM1 87–108 MHz (Demo Board Default)
 - FM2 86.5–109 MHz
 - FM3 87.3–108.25 MHz
 - FM4 76–90 MHz
 - FM5 64–87 MHz (Demo Board Default)
- Worldwide AM band support from 504 to 1750 kHz with 5 default sub-bands:
 - AM1 520–1710 kHz (Demo Board Default)
 - AM2 522–1620 kHz (Demo Board Default)
 - AM3 504–1665 kHz
 - AM4 520–1730 kHz
 - AM5 510–1750 kHz
- Worldwide SW band support from 2.3 MHz to 28.5 MHz with 16 default sub-bands:
 - SW1 5.6–6.4 MHz (Demo Board Default, for Si4844 only)
 - SW2 5.95–6.2 MHz
 - SW3 6.8–7.6 MHz (Demo Board Default, for Si4844 only)
 - SW4 7.1–7.6 MHz
 - SW5 9.2–10 MHz (Demo Board Default, for Si4844 only)
 - SW6 9.2–9.9 MHz
 - SW7 11.45–12.25 MHz (Demo Board Default, for Si4844 only)
 - SW8 11.6–12.2 MHz
 - SW9 13.4–14.2 MHz (Demo Board Default, for Si4844 only)
 - SW10 13.57–13.87 MHz
 - SW11 15–15.9 MHz (Demo Board Default, for Si4844 only)
 - SW12 15.1–15.8 MHz
 - SW13 17.1–18 MHz (Demo Board Default, for Si4844 only)
 - SW14 17.48–17.9 MHz
 - SW15 21.2–22 MHz (Demo Board Default, for Si4844 only)
 - SW16 21.45–21.85 MHz
- Twelve-position slide switch or one push button for selecting different bands according to the target application
- Two AAA battery operations with working voltage down to 2.0 V
- Economical potentiometer for frequency tuning replaces more expensive variable capacitor (PVC)
- Potentiometer and/or push button volume control
- FM 50 μ s or 75 μ s (default) de-emphasis
- FM stereo indication threshold 6 dB separation at 20 dB μ v RF input (default) or 12 dB separation at 28 dB μ v RF input
- 9-level Bass/Treble via push button control for FM
- 7-level Bass/Treble via push button control for AM/SW
- FM/AM/SW band indicator and frequency display in LCD
- 2x4 matrix keypad
- The frequency range of each band, the ST indication threshold, de-emphasis and AM channel space can be reconfigured by host MCU.

Si4840/44-DEMO

2. Overview

This manual describes the operation of the Silicon Labs Si4840/44-DEMO board, Rev 1.3, June 30, 2011. The Silicon Laboratories Si4840/44 DEMO board is designed with the 24-pin SSOP-packaged Si4840/44 chip, the revolutionary single chip AM/FM/SW receiver that integrates everything from antenna output to audio input and allows use of common and economical potentiometers to do the frequency tuning. It provides a complete portable analog tune digital display AM/FM/SW radio design. The LCD displays the tuning information. The Si4840/44-DEMO is designed with 1-layer PCB, allowing the lowest cost without sacrificing the RF performance. The demo board works with two AAA batteries and working voltage down to 2.0 V.

3. Description

Figure 1 and Figure 2 show the physical layout of the board with key components indicated.

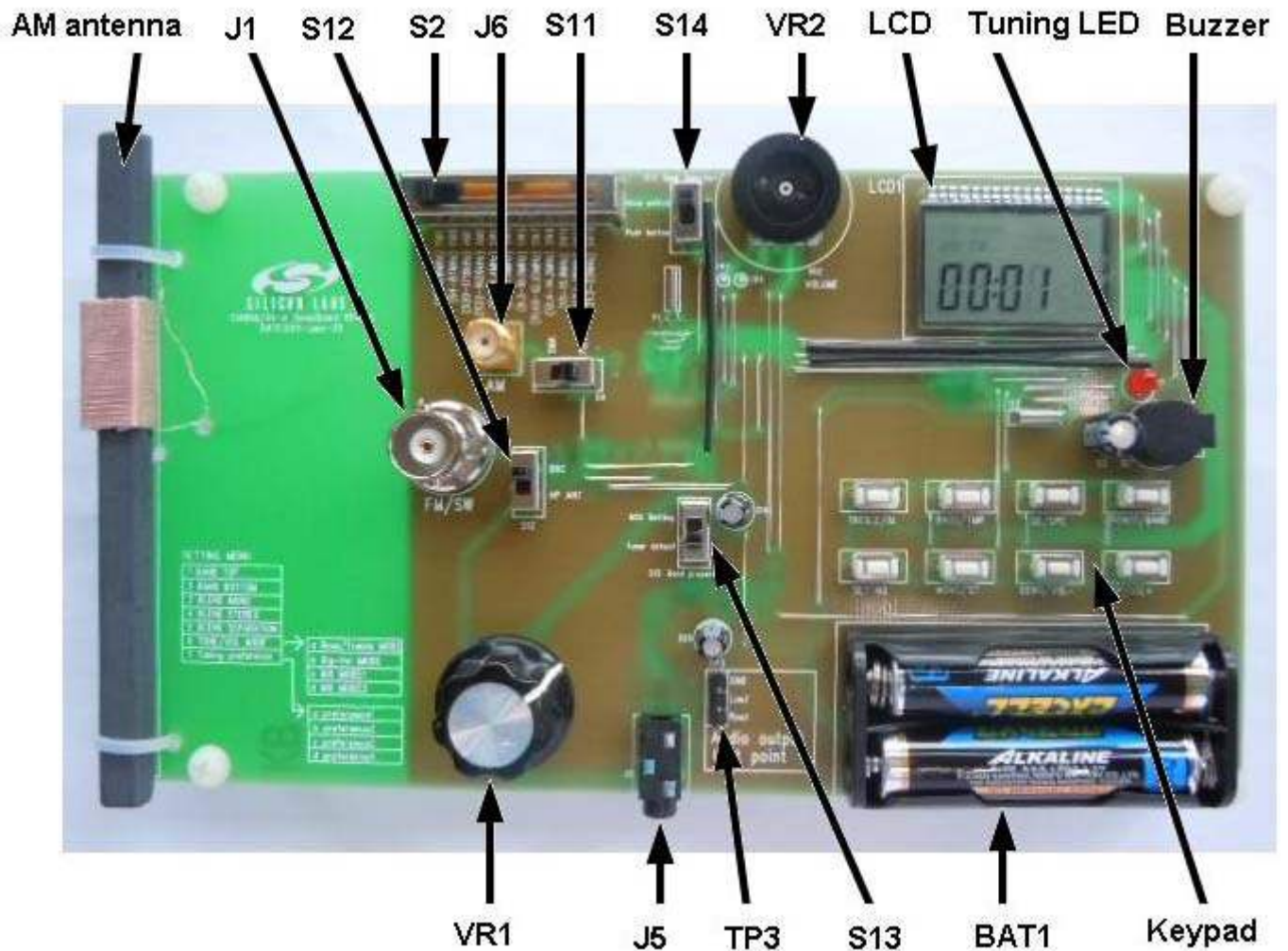


Figure 1. Si4840/44-DEMO Board Top Side in Time Mode

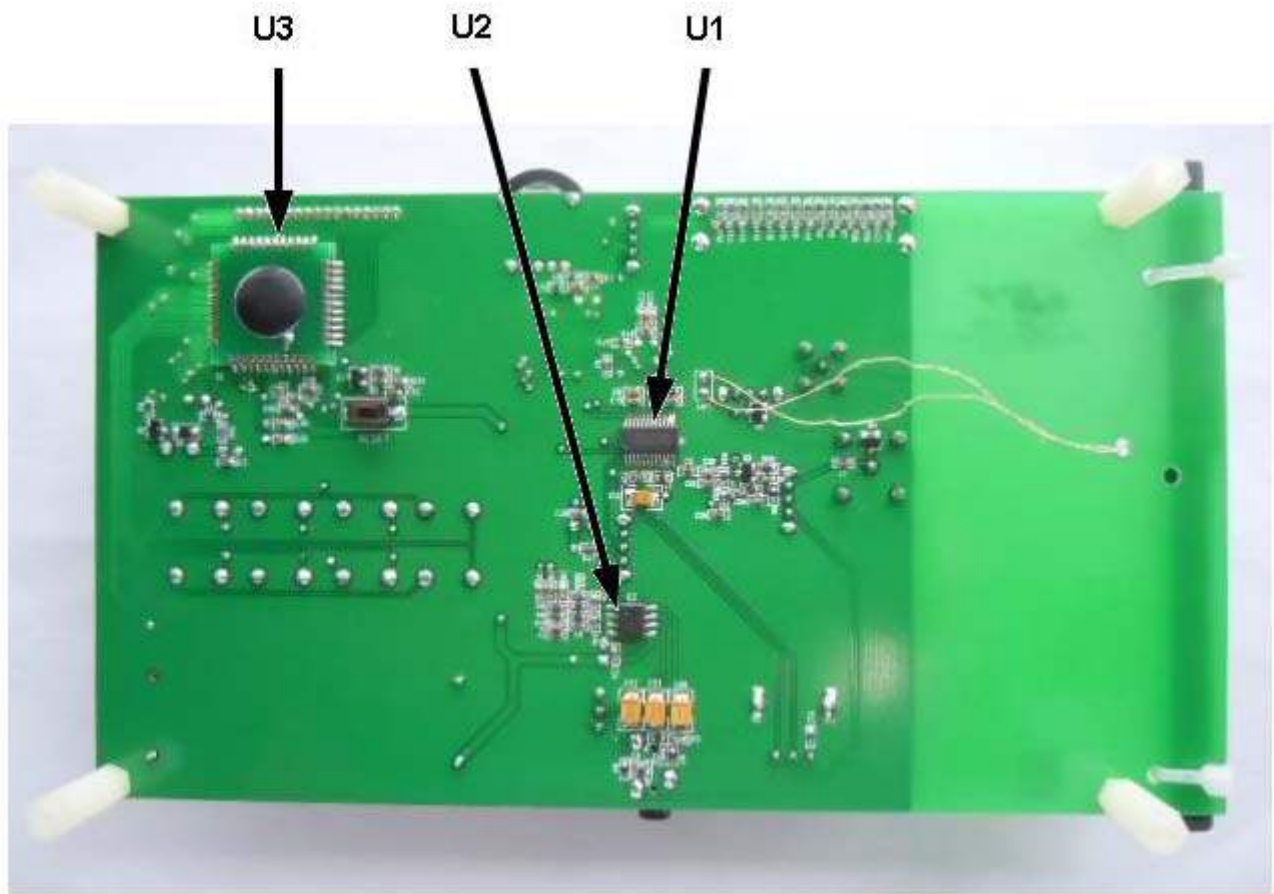


Figure 2. Si4840/44-DEMO Board Bottom Side

Power:

BAT1: 2 cells AAA battery compartment

Audio connectors:

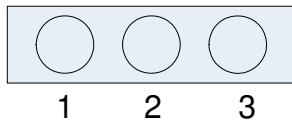
J5: Stereo audio headphone output

Antenna selections:

AM antenna: Ferrite stick antenna for AM

J6: SMA connector for AM conductive test

S11: AM antenna selection



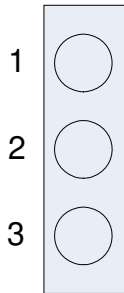
1-2: SMA for AM Conductive Test (J6)

2-3: AM ferrite antenna

J1: BNC connector for FM/SW conductive test or FM whip antenna

Si4840/44-DEMO

S12: FM antenna selection



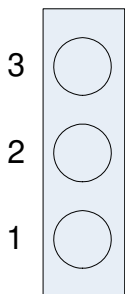
1-2 BNC (J1)

2-3 HP ANT (J5)

Radio Band selection:

The Demo board provides 2 methods to select the radio band. One is to use the slide switch (S2); the other is to use the POWER/BAND push button. S14 determines which method is in use.

S14:

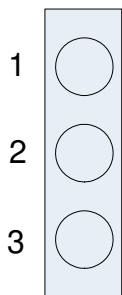


2-3: Use slide switch to select band

1-2: Use push button to select band

Radio Band Property setting:

S13:



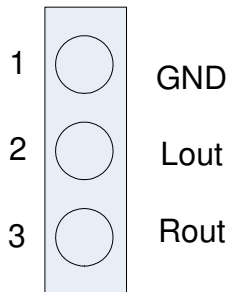
1-2: Use the keypad to set the band property via MCU

2-3: Use the tuner default band setting values

Audio output test point:

For general specification test, TP3 is the recommended audio signal test point. The audio test instrument should be connected to TP3 to get more accurate test results. J5 can also be used as an audio test point, but the test results may not be entirely accurate under some circumstances.

TP3:



Main components:

U1: Silicon Laboratories Si484x FM/AM/SW ATDD tuner

U2: Audio amplifier

U3: MCU

LCD: The digital display of tuning information

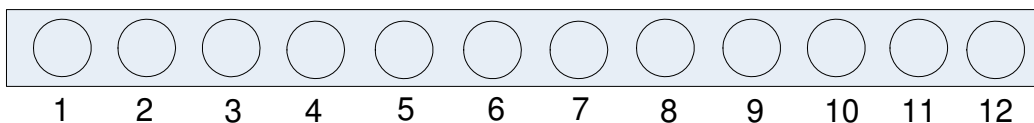
Control interface:

VR1: Frequency tuning wheel

VR2: Volume control wheel

S3~S10: The keypad for human interface

S2: Band slide switch for FM, AM, and SW



Band definition:

1: FM1 (87–108 MHz), De-emphasis=75 us, ST indication=6 dB separation@20 dB μ V

2: FM5 (64–87 MHz), De-emphasis=75 us, ST indication=6 dB separation@20 dB μ V

3: AM1 (520–1710 kHz), 10 kHz spacing

4: AM2 (522–1620 kHz), 9 kHz spacing

5: SW1 (5.6–6.4 MHz)

6: SW3 (6.8–7.6 MHz)

7: SW5 (9.2–10.0 MHz)

8: SW7 (11.45–12.25 MHz)

9: SW9 (13.4–14.2 MHz)

10: SW11 (15–15.9 MHz)

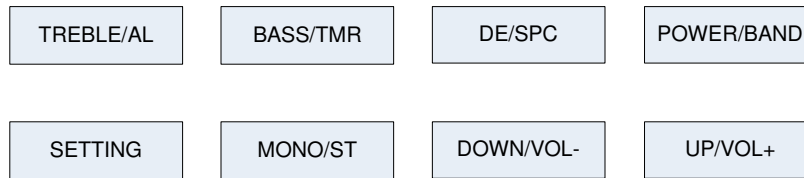
11: SW13 (17.1–18 MHz)

12: SW15 (21.2–22 MHz)

Si4840/44-DEMO

Human Interface:

There are 8 keys for controlling the demo board as shown below.



Each key can have a different function under each operating condition:

- **Time mode:** Radio function is disabled. LCD displays time. Buttons can be used to set time, alarm, etc.
- **FM/AM/SW Radio mode:** Tuner IC works in power up mode. Radio function is enabled. LCD displays the radio station parameters. Buttons are used to adjust radio settings. The functions of the buttons are summarized in Table 1. The FM/AM/SW radio parameters which can be configured are listed in Table 2.

Table 1. Key Function Description

| Button | | Time Mode Tuner Off | FM/AM/SW Radio Mode Tuner On |
|------------|----------------|--------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| POWER/BAND | Hold Time < 1s | None | Change between FM, AM, and SW (there are 1 FM band, 1 AM band and 8 SW bands) |
| | Hold Time > 1s | Enable radio | Disable radio function and enter Time mode. (Radio parameters will be saved to MCU.) |
| DE/SPC | | None | FM mode: Change De-emphasis, between 50 and 75 us. AM mode: Change channel space, between 9 kHz and 10 kHz. |
| BASS/TMR | | Enter or quit setting menu. | Decrease Bass/Treble level by 1 step. |
| TREBLE/AL | | Enable or disable the alarm function; enter or quit alarm setting menu. | Increase Bass/Treble level by 1 step. |
| UP/VOL+ | Hold Time < 1s | In setting menu, change the current time/alarm parameter by one unit per each press. | In radio setting menu, change the current parameter by one unit per each press. In radio working mode, increase volume 1 step per each press. |
| | Hold Time > 1s | In setting menu, change the current time/alarm parameter automatically. | In radio setting menu, change the current parameter automatically. In radio working mode, increase volume level automatically until to maximum. |
| DOWN/VOL- | Hold Time < 1s | In setting menu, change the current time/alarm parameter by one unit per each press. | In radio setting menu, change the current parameter by one unit per each press. In radio working mode, decrease volume 1 step per each press. |

Table 1. Key Function Description (Continued)

| Button | | Time Mode Tuner Off | FM/AM/SW Radio Mode Tuner On |
|---------|----------------|-------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| | Hold Time > 1s | In setting menu, change the current time/alarm parameter automatically. | In radio setting menu, change the current parameter automatically. In radio working mode, decrease volume level automatically until to minimum. |
| MONO/ST | | None | FM mode: change between forced mono audio and ST audio. |
| SETTING | Hold Time < 1s | None | In radio setting menu, change the selected item per each press. |
| | Hold Time > 1s | None | Quickly return to FM working mode. |

Table 2. Radio Configuration Parameters

| FM parameter | AM Parameter | SW Parameter |
|----------------------------------------------------------|----------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| Bass/Treble: 0-8 Default: 4 | Bass/Treble: 1-7 Default: 3 | Bass/Treble: 1-7 Default: 3 |
| Digital Volume: 0-63 Default: 63 | Digital Volume: 0-63 Default: 63 | Digital Volume: 0-63 Default: 63 |
| Band Top: Max 109 MHz Default: 108 MHz | Band Top: Max 1750 kHz Default: 1710 kHz | Band Top: Max 28.5 MHz Default: 6.4/7.6/10/12.25/14.2/15.9/18/22 MHz for SW1 to SW8 respectively. |
| Band Bottom: Min 64 MHz Default: 87.5 MHz | Band Bottom: Min 504 MHz Default: 522 MHz | Band Bottom: Min 2.3 MHz Default: 5.6/6.8/9.2/11.45/13.4/15/17.1/21.2 MHz for SW1 to SW8 respectively |
| Band Range: Max 22 MHz | Band Range: Max 2.2 MHz | Band Range: Max 1.1 MHz |
| De-emphasis: 50 or 75 μ s Default: 75 μ s | Channel space: 9 or 10 kHz Default: 9 kHz | |
| Blend mono: 0-127 dB μ V Default: 8 dB μ V | | |
| Blend stereo: 0-127 dB μ V Default: 49 dB μ V | | |
| Blend separation: 0-100% Default: 50% | | |
| Tone/VOL mode: a-d Default: d | | |
| Tuning preference: a-d Default: a | | |

Notes:

Tone/VOL mode has 4 selections:

- Bass/treble mode: no digital volume control, fixed volume level at 59.
- Digital volume mode: no bass/treble effect, volume levels from 0 to 63.
- Mixed mode 1: bass/treble and digital volume coexist, volume levels from 0 to 63, scale to 0~59.
- Mixed mode 2: bass/treble and digital volume coexist, volume levels from 0 to 63.

The tuning preference of FM mode has 4 selections:

- Preference 1: When tuning to adjacent channels, allow stereo separation and stereo indicator is on, volume level decreases by 2 dB.
- Preference 2: When tuning to adjacent channels, allow stereo separation and stereo indicator is on, volume level is unchanged.
- Preference 3: When tuning to adjacent channels, disable stereo separation and stereo indicator is off, volume level decreases by 2 dB.
- Preference 4: When tuning to adjacent channels, disable stereo separation and stereo indicator is off, volume level is unchanged.

The tuning preference of SW mode has 2 selections:

- Preference 1: When tuning to adjacent channels, the volume level decreases by 2 dB.
- Preference 2: When tuning to adjacent channels, the volume level remains unchanged.

There is no tuning preference selection for AM mode.

4. Operation

The Si4840/44-Demo Board, a complete analog tune and digital display radio, provides two major modes of operation: Time Mode and FM/AM/SW Radio Mode.

4.1. Time Mode

Put 2 AAA batteries into the battery compartment. The board will automatically enter Time Mode and display the time. The demo board display in Time Mode is illustrated in Figure 1.

4.1.1. Time Setting

The time default value is 00:00 and can be set to the correct time manually when needed.

1. In Time Mode, press the BASS/TMR button to enter the setting menu. The default is to set the minute item first. Press this button again to select the hour item. The selected item flashes.
2. While the selected item is flashing, press the DOWN/VOL- and UP/VOL+ button to set the desired time.
3. When you have finished setting the time, press the BASS/TMR button to quit the setting menu. The MCU automatically quits the setting menu if there is no operation within 2 seconds.

4.1.2. Alarm Setting

1. In Time Mode, press the TREBLE/AL button to enable or disable the alarm function, and enter the setting menu automatically when the alarm is enabled. Once you have entered the setting menu, the default is to set the minute item first. Press this button again to select the hour item. The selected item flashes.
2. While the selected item is flashing, press the DOWN/VOL- and UP/VOL+ button to set the desired time.
3. When you have finished the alarm setting, press the TREBLE/AL button to quit the setting menu. The MCU automatically quits the setting menu if there is no operation within 2 seconds.
4. If the alarm is enabled and the alarm setting time is matched, the radio will be automatically turned on after the buzzer sounds for 5 seconds.
5. The radio will be turned off and the demo board will go into sleep mode automatically if there is no operation on the buttons within 15 minutes; if there is any operation on the buttons, the auto-sleep function will be disabled. The radio keeps working throughout this time.

4.2. FM/AM/SW Radio Mode

In Time Mode, long press (hold time >1s) the POWER/BAND button or when the alarm time is reached, the device will enter FM/AM/SW mode. The LCD displays the following information: band indicator, band frequency indicator, stereo indicator, and sleep indicator in case radio is automatically turned on by the alarm.

The demo board display in FM/AM/SW Mode is illustrated in Figure 3.

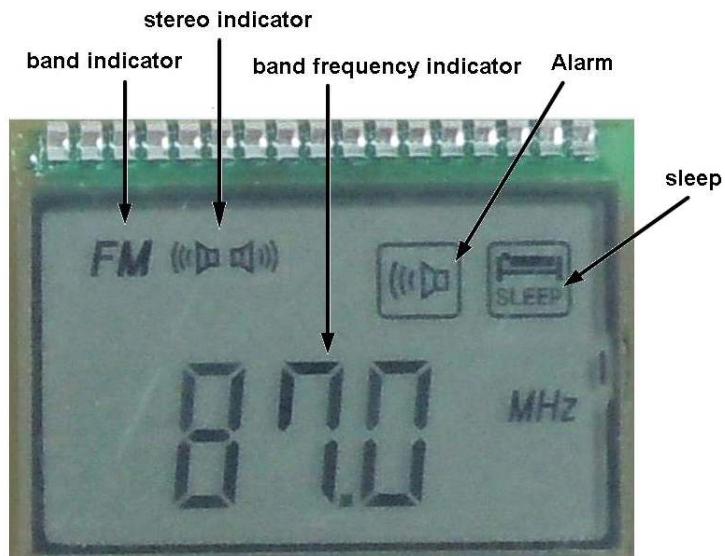


Figure 3. LCD Display in FM Radio Mode

The demo board provides two methods to select the radio band. One is to use the slide switch (S2). The other is to use the POWER/BAND push button. S14 determines which method is in use.

The demo board also provides two methods to set the band property. One is to use the tuner default values; the other is to use the keypad to reconfigure the band property value via the MCU. S13 determines which method is in use. If you use the tuner default values, the band property is fixed and cannot be reconfigured. Refer to section “4.2.1. MCU Setting Band Property” for the operation details for setting the band property using the keypad.

To operate the demo board, follow these procedures:

1. According to the desired radio band selection method, set S14 to use the slide switch or push button.
2. According to the desired radio band property, set S13 to use tuner default values or reconfigure the band property.
3. Hold the POWER/BAND push button (hold time >1s) or when the alarm time is reached, the device will enter FM/AM/SW Radio Mode.
4. Use slide switch S2 or press the POWER/BAND push button to select the desired band.
5. Refer to section “4.2.1. MCU Setting Band Property” or section “4.2.2. MCU Setting Radio Working Mode” to reconfigure the band property or radio working mode if necessary.
6. Rotate the turning wheel and find the desired radio station with the help of the LCD display and/or tuning indicator D1.
7. Rotate the volume control wheel VR2 and/or press the DOWN/VOL- or UP/VOL+ button to get a comfortable volume. Press the BASS/TMR or TREBLE/AL button to get the desired bass/treble level.

Notes:

- For FM listening, the earphone cable must be connected to the board when S12 is set to HP ANT or an external antenna must be connected to the BNC connector when S12 is set to BNC.
- For AM listening, the ferrite antenna must be connected to the board and the S11 is set to Ferrite before turning on the radio or switching the band to AM.

Si4840/44-DEMO

4.2.1. MCU Setting Band Property

The demo board provides the function that the band property can be set by MCU. The band property includes:

- Band top
- Band bottom
- Blend mono (only for FM)
- Blend stereo (only for FM)
- Blend separation (only for FM)
- De-emphasis (only for FM)
- Channel Space (only for AM)

The setting menu is illustrated in Figure 4.

To set the band properties, follow these steps:

1. Press the SETTING button to enter the setting menu and select the item to be set. The selected item flashes for 1 second, then automatically switches to its current value.
2. While the value is flashing, press the DOWN/VOL- or UP/VOL+ button to set the desired value within 3 seconds.
3. Repeat steps 1 and 2 to finish setting the band properties.
4. When the band properties are set, the MCU automatically quits the setting menu if there is no operation within 3 seconds.
5. In FM working mode, press the DE/SPC button to set the De-emphasis to 50 or 75 μ s.
6. IN AM working mode, press the DE/SPC button to set the Channel Space to 9 kHz or 10 kHz.

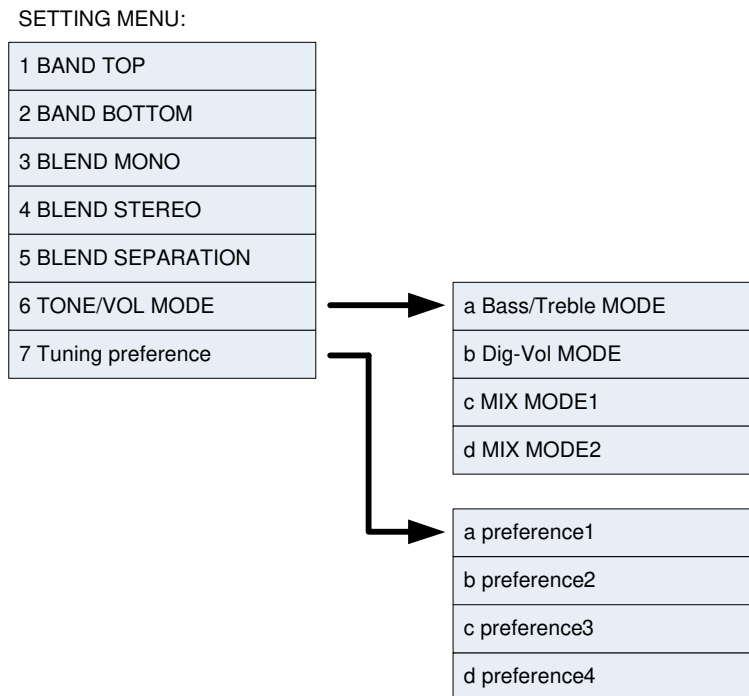


Figure 4. Setting Menu

4.2.2. MCU Setting Radio Working Mode

The host MCU can set the radio working mode. The working mode includes:

- Tone/volume mode (only for FM mode), item 6 in the setting menu
- Tuning preference (only for the FM and SW), item 7 in the setting menu
- Forced mono audio/ST audio (only for FM)

To set the radio working mode, follow these steps:

1. Press the SETTING button to enter item 6. The LCD displays the item number st6 for 1 second, then automatically switches to its mode indication.
2. Press the DOWN/VOL– or UP/VOL+ button to select the desired mode within 3 seconds.
3. Repeat steps 1 and 2 to set the tuning preference by setting item 7.
4. When the radio working mode is set, the MCU automatically quits the setting menu if there is no operation within 3 seconds.
5. Press the MONO/ST button to select forced mono audio or ST audio in FM mode when necessary.

Si4840/44-DEMO

5. Bill of Materials

- ATDD AM/FM/SW receiver IC Si484x with external 32.768 kHz crystal oscillator support
- LM4910MA Audio Amplifier IC
- TM8795 MCU

See Table 3 for details.

Table 3. Si4840/44-DEMO Board Bill of Materials Rev. 1.3

| Item | Qty | Reference | Description | Value |
|------|-----|---------------------------------|------------------------|---------|
| 1 | 12 | C1-2, C6, C19, C24, C37-42, C44 | CAP,SM,0603,X7R | 0.1u |
| 2 | 2 | C5, C36 | CAP,SM,0603,X7R | 0.47u |
| 3 | 3 | C8-10 | CAP,SM,0603,COG | 100p |
| 4 | 1 | C33 | CAP,SM,0603,COG | 10p |
| 5 | 4 | C4, C7, C12, C21 | CAP,SM,0603,X7R | 10u |
| 6 | 4 | C28-29, C32, C35 | CAP,SM,0603,COG | 22p |
| 7 | 2 | C11, C20 | CAP,SM,0603,COG | 330p |
| 8 | 2 | C30-31 | CAP,SM,0603,COG | 33n |
| 9 | 1 | C34 | CAP,SM,0603,COG | 33p |
| 10 | 1 | C15 | CAP,SM,0603,X7R | 4.7u |
| 11 | 1 | C13 | CAP,SM,1210,X7R | 47u |
| 12 | 2 | C18, C22 | CAP,SM,0603,COG | 820p |
| 13 | 3 | C23, C26, C27 | CAP,SM,1210,X7R | 220u |
| 14 | 2 | C14, C25 | Electrolytic capacitor | 100u/4V |
| 15 | 1 | C3 | Electrolytic capacitor | 220u/4V |
| 16 | 1 | R27 | RES,SM,0603 | 100R |
| 17 | 1 | R34 | RES,SM,0603 | 100k |
| 18 | 1 | R32 | RES,SM,0603 | 10R |
| 19 | 2 | R3, R42 | RES,SM,0603 | 10k |
| 20 | 1 | R41 | RES,SM,0603 | 120k |
| 21 | 2 | R17, R22 | RES,SM,0603 | 12k |
| 22 | 2 | R1-2 | RES,SM,0603 | 1M |
| 23 | 2 | R4, R31 | RES,SM,0603 | 1k |
| 24 | 1 | R24 | RES,SM,0603 | 200R |

Table 3. Si4840/44-DEMO Board Bill of Materials Rev. 1.3 (Continued)

| Item | Qty | Reference | Description | Value |
|------|-----|------------------------------|----------------------------------|---------------|
| 25 | 1 | R13 | RES,SM,0603 | 22R |
| 26 | 2 | R5-6 | RES,SM,0603 | 2k |
| 27 | 2 | R16, R18 | RES,SM,0603 | 2.2k |
| 28 | 1 | R46 | RES,SM,0603 | 4.7M |
| 29 | 2 | R19-20 | RES,SM,0603 | 6.8k |
| 30 | 1 | R21 | RES,SM,0603 | NP |
| 31 | 1 | R7 | RES,SM,0603,Tolerance $\pm 1\%$ | 10k 1% |
| 32 | 1 | R29 | RES,SM,0603,Tolerance $\pm 1\%$ | 160k 1% |
| 33 | 9 | R9-12, R14-15, R28, R33, R35 | RES,SM,0603,Tolerance $\pm 1\%$ | 20k 1% |
| 34 | 1 | R43 | RES,SM,0603,Tolerance $\pm 1\%$ | 30k 1% |
| 35 | 1 | R36 | RES,SM,0603,Tolerance $\pm 1\%$ | 33k 1% |
| 36 | 1 | R8 | RES,SM,0603,Tolerance $\pm 1\%$ | 40k 1% |
| 37 | 1 | R44 | RES,SM,0603,Tolerance $\pm 1\%$ | 47k 1% |
| 38 | 1 | U1 | SI484x-A SSOP24 | Si4844-A |
| 39 | 1 | U2 | LM4910MA,SO8 | LM4910MA |
| 40 | 1 | U3 | TM8795 44 PIN | TM8795 44 PIN |
| 41 | 1 | Q2 | TRANSISTOR NPN SOT23 | 2N3904 |
| 42 | 1 | Q1 | TRANSISTOR NPN SOT23 | 2SC9018 |
| 43 | 1 | Q3 | TRANSISTOR NPN SOT23 | 2N3906 |
| 44 | 2 | D2 D4 | DIODE,SM,ESD,SOT23 | BAV99 |
| 45 | 4 | B4, B5, B6, B7 | FERRITE BEAD,SM,0603 | 2.5k/100M |
| 46 | 1 | B1 | FERRITE BEAD,SM,0603 | NP |
| 47 | 1 | BZ1 | BUZZER | BUZZER |
| 48 | 2 | Y1-2 | CRYSTAL | 32.768KHz |
| 49 | 1 | D1 | LED | LED |
| 50 | 1 | D6 | 1N4148 | 1N4148 |
| 51 | 1 | J5 | Stereo earphone jack with switch | 3.5mm |
| 52 | 1 | L1 | RES,SM,0603 | 0R |
| 53 | 1 | L2 | IND,SM,0603 | 270nH |

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Table 3. Si4840/44-DEMO Board Bill of Materials Rev. 1.3 (Continued)

| Item | Qty | Reference | Description | Value |
|------|-----|-----------|----------------------------------|--------------------|
| 54 | 2 | L3, L4 | IND,SM,0603 | 120nH |
| 55 | 1 | LCD1 | LCD | LCD |
| 56 | 1 | J1 | BNC VERTICAL | BNC for FM testing |
| 57 | 1 | J6 | SMA VERTICAL | SMA for AM testing |
| 58 | 1 | ANT1 | AW ferrite stick antenna | 220uH |
| 59 | 1 | BAT1 | BATTERY BOX ,AAA*2 SIZE | |
| 60 | 4 | S11-14 | One pole two throw switch | |
| 61 | 1 | S2 | Single pole twelve throw switch | |
| 62 | 8 | S3-10 | Push button DIP | Push button |
| 63 | 1 | S1 | Push button SM | Push button |
| 64 | 1 | TP3 | CONN,TH,1x3,HDR | CONN,TH,1x3,HDR |
| 65 | 1 | VR1 | 100k,±10%,Variable resistor(POT) | 100k |
| 66 | 1 | VR2 | 10k,±20%,Variable resistor(POT) | 10k |

6. Schematics and Gerbers

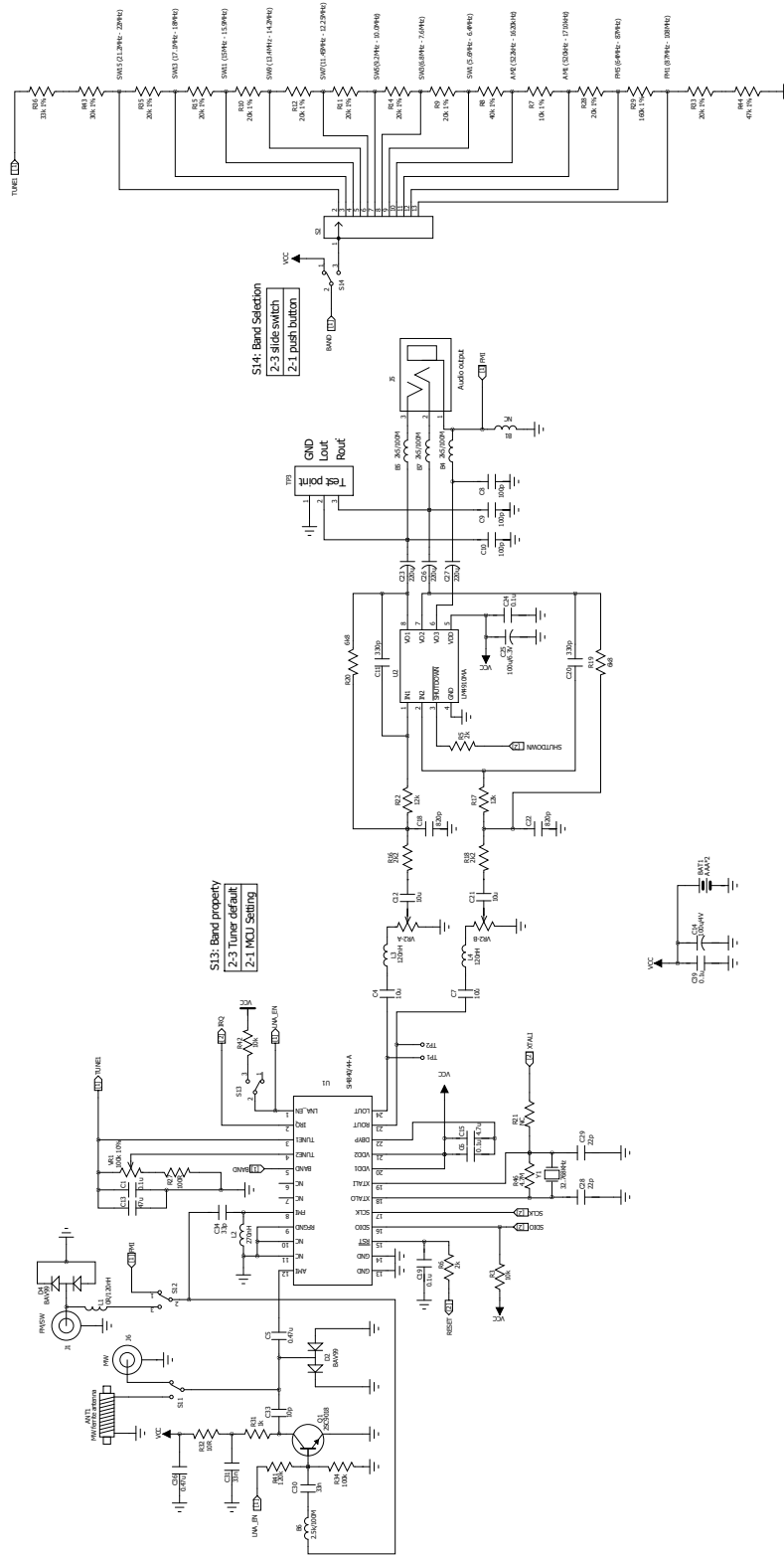


Figure 5. Si4840/44 DEMO Board Rev 1.3 Schematic—Radio and Audio Portions

Si4840/44-DEMO

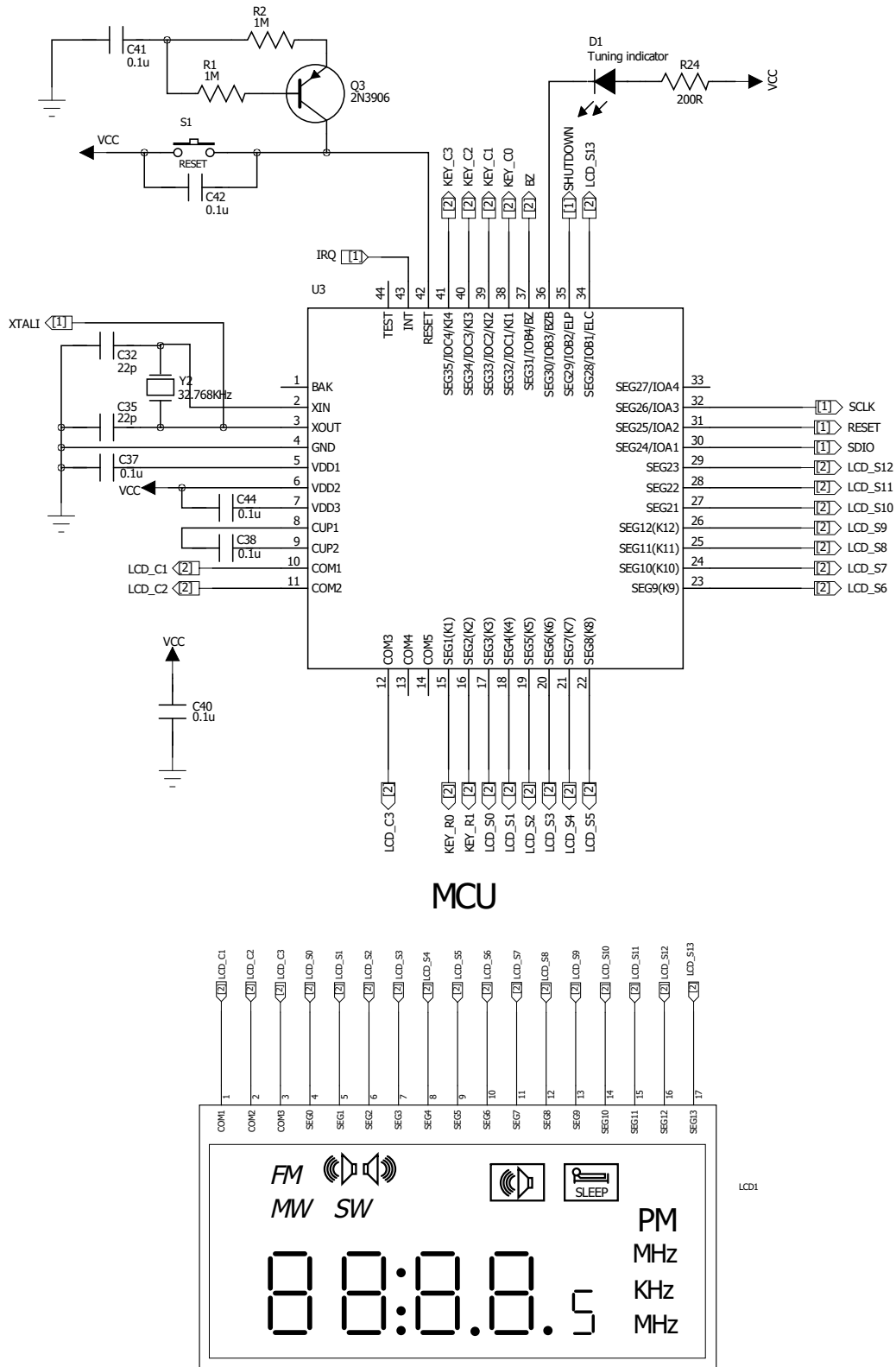
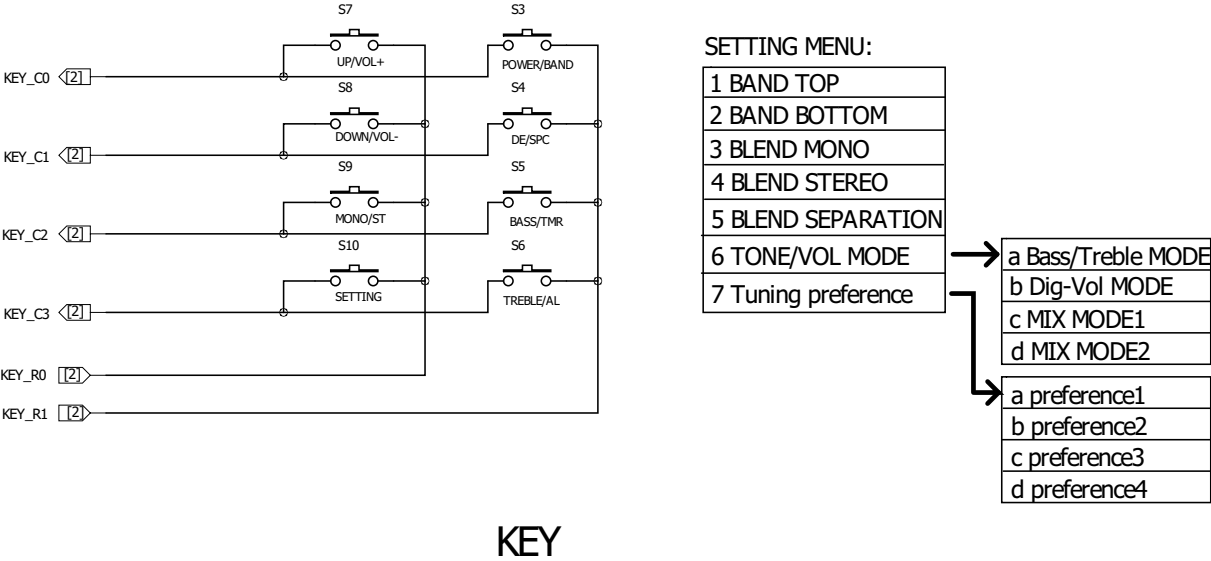
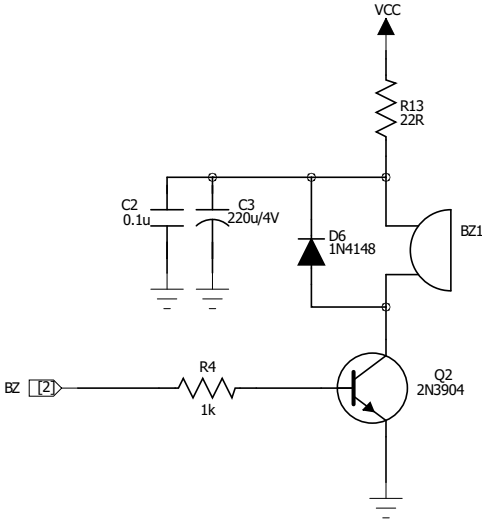


Figure 6. Si4840/44 DEMO Board Rev. 1.3 Schematic – MCU Portion (1 of 2)



KEY



BUZZER

Figure 7. Si4840/44 DEMO Board Rev. 1.3 Schematic – MCU Portion (2 of 2)

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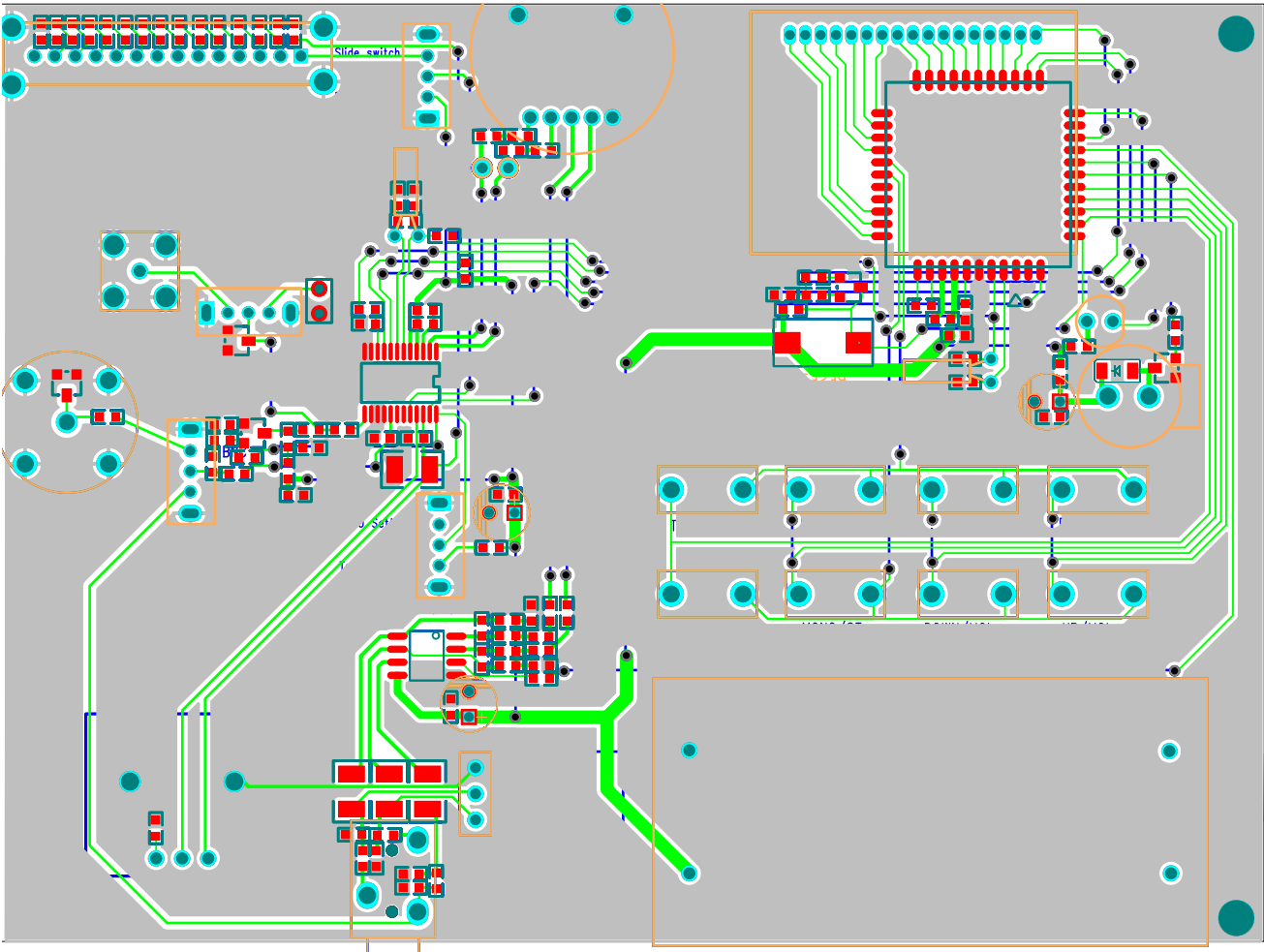
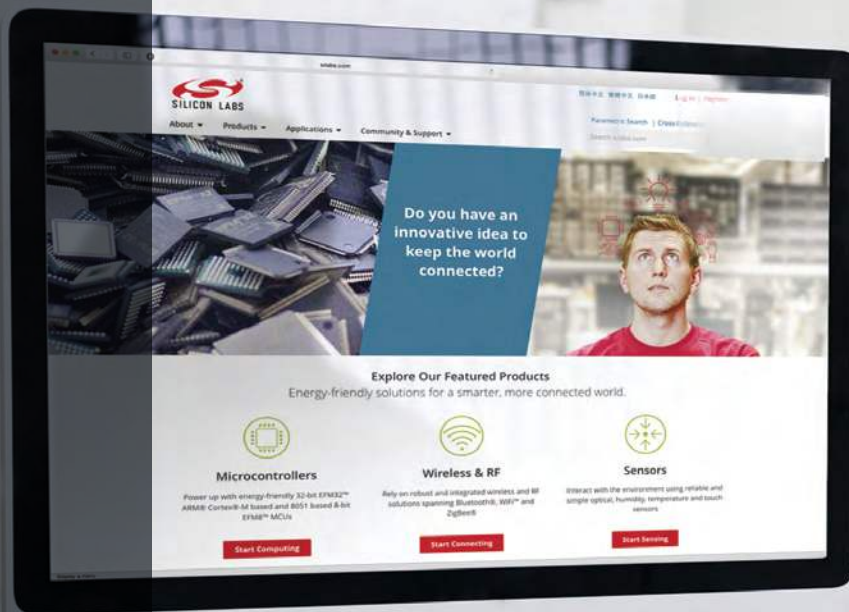


Figure 8. Si4840/44-DEMO Board Gerber Rev 1.3

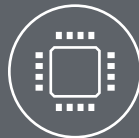
NOTES:



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