

Hacking the Si4734

Kchibo KK-D48L Circuit Description

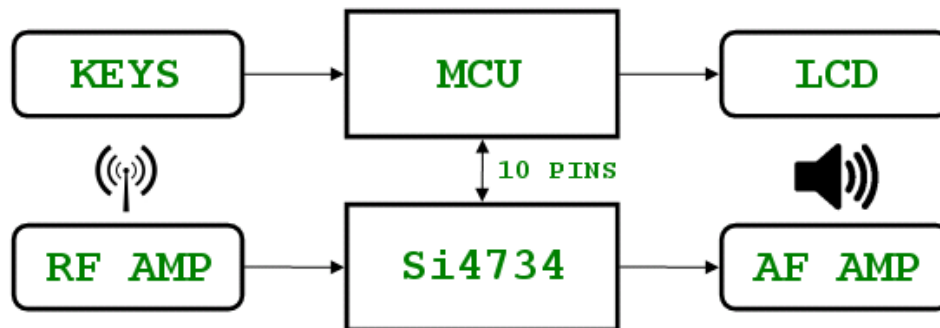
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The Kchibo KK-D48L is a shortwave receiver based on Silicon Labs' Si4734 chip. This IC contains an automatic antenna tuner, I/Q mixers for image rejection, low-IF DSP filtration and demodulation, and a microcontroller. The D48L is 4.8 ounces and takes up ~11.9 cubic inches.



The MCU board consists of a microcontroller and user interface (keypad and display). The DSP board houses the Si4734 tuner chip, radio frequency (RF), audio frequency (AF), and power circuitry. The two boards are attached to one other via a 10-pin connector, allowing MCU control.

The MCU board consists of a ~48-pin MCU on a COB assembly (90 memories), tuning fork, three SMT transistors, and 220 µF decoupling capacitor. This section also houses inputs including: 12 buttons (4 housed under a circle), reset dimple, and a light sensor. In addition this half of the radio contains outputs: a backlit LCD display, power indicator LED, and 16-ohm 250 mW speaker.

12 BUTTON INPUTS
Power, Volume, Key Lock
Memory Store, Memory Address, Memory Scan
Band (FM/MW/SW), Meter Band (SW)
Up, Down, Plus, Minus

LCD DISPLAY OUTPUT
Frequency, MHz/kHz, MW/FM/FM-Stereo, SW Meter Band
SNR in dB, Signal Level in dBµV, Memory
Volume, Lock, Time, Date, Sleep
Power Level, External Power

The **DSP section** houses a 3.7 Volt lithium-ion battery with a 470 µF decoupling capacitor, and external power jack. The MCU section receives power via **PIN_4**, through a protection diode. It receives ground via **PIN_9**, which comes from the ground strip located underneath the Si4734. RF amplifier and Si4734 power is MCU dispersed (**PIN_1**) and controlled (**PIN_2**) via a transistor. The Si4734 receives power through an RF choke (preventing RF from entering) and is decoupled via a 1000 µF electrolytic capacitor. The MCU controls (**PIN_3**) power to the AF amplifier through transistor switching. Hence, the MCU can shut down the DSP board for low-power (sleep) mode.

The **antenna section** of the DSP board contains three inputs: a 3.6" MW ferrite rod, an FM and SW aerial, and an external antenna jack. The MW ferrite rod input is fed into the Si4734 **AMI** (via a DC isolation capacitor) and **RFGND** pins. The FM / SW inputs are diode protected and must pass a small capacitor (RF-only). The RF energy is then transistor amplified in a common-emitter configuration. The amplified signal undergoes **LC T-section low pass filtering** (excluding UHF and above) before entering the Si4734's FM input or **FMI** pin. The amplified signal can also be switch fed (shielding MW) via the Si4734's **GPO1** pin (under direct MCU control) into the MW ferrite tank via an inductor. This inductor acts as a VHF RF choke and prevents VHF and higher from entering.

The **Si4734** chip has its **SEN** (serial enable) pin grounded. The chip is under complete MCU control via four connector pins: **PIN10** to **RST** (reset), **PIN_6** to **RCLK** (main clock), **PIN_8** to **SCLK** (data clock), and **PIN_7** to **SDIO** (data input/output). The Si4734 uses an **I2C** bus: address **0x22**.

The **audio section** consists of a **SA1622** Stereo Power Amplifier chip. It receives input from the Si4734's **LOUT** and **ROUT** pins. The chip has a 1000 µF decoupling capacitor and 100 µF ripple capacitor. The SA1622 **VOLUME** pin is set to a fixed value (meaning volume is MCU controlled via the Si4734 IC). The SA1622 **SWITCH** pin has two inputs: it is in **BTL** (bridge tied load) mode with the internal speaker and stereo mode with an external headphone. However, the MCU can also put the chip into BTL mode via **PIN_5** whenever the signal level drops below **25 dBµV**, improving SNR.

10-PIN CONNECTOR	
PIN_1 : Power Si4734/RF-Amplifier	PIN_6 : Si4734 RCLK (main clock)
PIN_2 : Power Si4734/RF-Amplifier	PIN_7 : Si4734 SDIO (data I/O)
PIN_3 : Power Audio Amplifier	PIN_8 : Si4734 SCLK (data clock)
PIN_4 : Power +3.7 Volt	PIN_9 : Ground
PIN_5 : Force FM Mono	PIN10 : Si4734 RST (reset)

The **D48L** is an admirable design; however, there is room for improvement. Software wise, the radio should disable soft muting and include 1-kHz tuning steps. The SW antenna setup could be improved with a toroidal tank tuned by the Si4734's capacitor. The Si4734 should idyllically be setup to utilize its interrupt line **GPO2/INT**; and be clocked via its own fork and **GPO3/DCLK**. Also, volume is controlled better using a potentiometer at the SA1622, not via the Si4734. The ground plane on the DSP board should be more extensive and there is no RF shielding on the MCU board.

REFERENCE

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http://home.comcast.net/~phils_radio_designs

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