



Board Layout & Guidelines Using the
AM/FM Tuner from Silicon Labs

Agenda

- ◆ Company overview
- ◆ Broadcast audio product portfolio
- ◆ Si473x block diagram and technical highlights
- ◆ Design and layout guidelines
- ◆ Support resources



Silicon Labs Company Background

- ◆ Founded in 1996 to design innovative mixed-signal ICs
 - More than 2 billion mixed-signal ICs shipped
- ◆ Established global leader
 - 725 Employees
 - 800 patents issued or pending
 - Elite, global design team
- ◆ Committed to highest quality standards
 - ISO 9001/14001 certified company
 - ISO/TS 19649 compliant



Company Headquarter in Austin, TX



Silicon Labs Product Portfolio

Access	MCU	Broadcast	Timing	Wireless	Power
CMOS Integration	Mixed-Signal Capability	CMOS RF Demod expertise	DSPLL [®] Technology	Short-Range RF	High-Voltage Expertise
ProSLIC [®] Modems Opto ICs	Connectivity Low-Power Automotive	AM/FM Rx/Tx Video Products	XO/VCXO Clocks CDRs	EZRadio [®] EZRadioPRO [™]	PoE Isolation, PMU Controller



Silicon Labs Offers Best Performance

- ◆ Most adjustable parameters
 - Stereo blend threshold
 - Soft mute parameters
- ◆ Reliable and proven seek algorithm
 - Faster, more reliable than competition
 - Multiple seek qualifiers for AM and FM
- ◆ Market leader in RDS receivers
 - Advanced on-chip processing increases range and accuracy of received RDS data
- ◆ Best interference performance
 - Best selectivity and sensitivity in the presence of adjacent, alternate and multiple interferers



**Tune in with Silicon Labs,
You Can Hear the Difference**

Single-Chip Broadcast Radio Solutions

The S147x family of broadcast audio solutions is the industry's first to leverage digital integration and 100% CMOS, resulting in completely integrated, easy-to-use solutions that require only two external components and less than 15 mm² of board space. Leveraging Silicon Labs' proven digital low-IF receiver and transmitter architectures and frequency synthesizer technology, the S147x family delivers superior RF performance and interference rejection. Digital signal processing is utilized to provide optimum sound quality under varying signal conditions. The S147x family provides unmatched design flexibility with a complete footprint-compatible portfolio of AM and FM solutions.

Footprint Compatible Portfolio

Single PCB Footprint Actual Size

- S14702/03**
 - FM receiver
 - RDS (S14703)
- S14704/05**
 - FM receiver
 - RDS (S14705)
 - No external antenna required
- S14710/11**
 - FM transmitter
 - RDS (S14711)
- S14712/13**
 - FM transmitter
 - RDS (S14713)
 - Receive power scan (RPS)
- S14720/21**
 - FM transmitter
 - RDS (S14721)
 - No external antenna required
- S14730/31**
 - AM/FM receiver
 - RDS (S14731)

USB FM Radio Reference Design

- FM Radio Tuner
- CB051F321 USB MCU
- Radio Player for PC

silabs.com/USBRadio

Product details: www.silabs.com/Audio

MCU | TIMING | POWER | BROADCAST | WIRELINE | WIRELESS



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www.silabs.com

Layout-Compatible Product Portfolio

Si4702/03

- FM receiver
- RDS (Si4703)

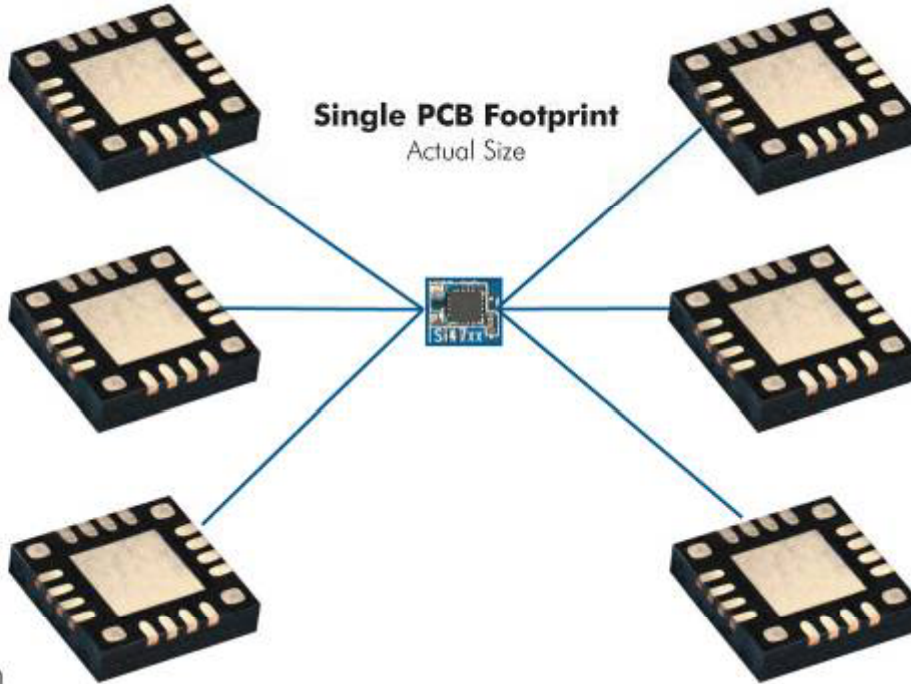
Si4704/05

- FM receiver
- RDS (Si4705)
- No external antenna required

Si4710/11/12/13

- FM transmitter
- RDS (Si4711/13)
- Receive power scan (Si4712/13)

Single PCB Footprint
Actual Size



Si4720/21

- FM transceiver
- RDS (Si4721)
- No external antenna required

Si4730/31

- AM/FM receiver
- RDS (Si4731)

Si4734/35

- AM/FM/SW/LW receiver
- RDS (Si4735)

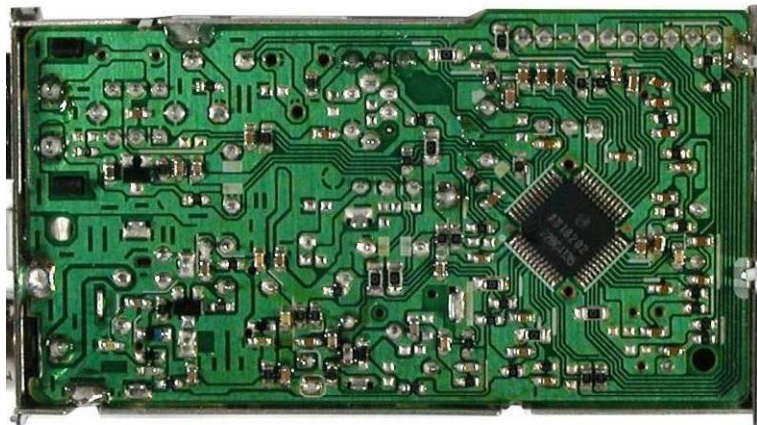
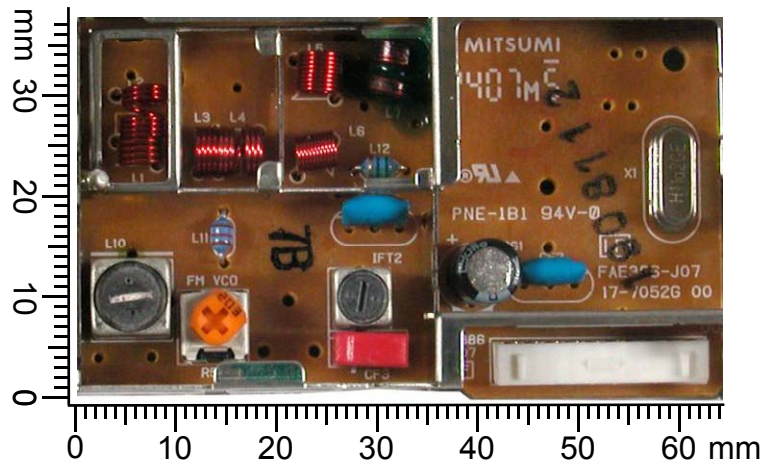
Si4736/37/38/39

- FM weather band receiver
- RDS (Si4737/39)

- ◆ Comprehensive layout-compatible broadcast portfolio
- ◆ Single footprint supports full product line
- ◆ Reduces design efforts and speeds time to market
- ◆ Enables flexible OEM product portfolio with different features

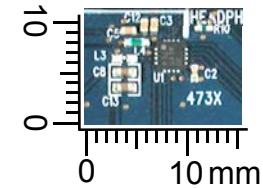
First Fully Integrated AM/FM Receiver

Competitive Solution



45 cm²

Silicon Labs' Solution



1.5 cm²

- ◆ Simplifies customer design
 - Reduces cost
 - Smallest footprint
 - Best performance
 - Most features
 - **All 3x3 mm Si47xx parts are layout compatible**

No Factory-Tuned Components

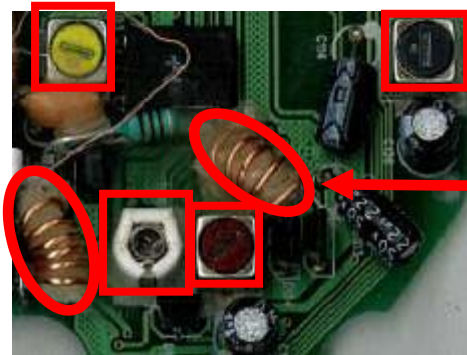
Existing Solutions

- ◆ Require hand tuned inductors to adjust for antenna variance
- ◆ Additional components, production time and manufacturing cost
- ◆ Limits manufacturing sites
- ◆ Higher fallout rate and variability

Silicon Labs Solution

- ◆ Auto detects and adjusts for antenna inductance
- ◆ Low BOM count with standard production flow
- ◆ Highly accurate digital tuning

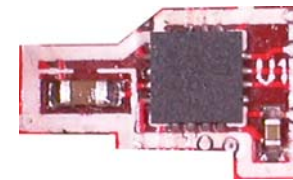
Highly integrated design eliminates factory alignment



Manually tuned inductor

Hand spread and waxed

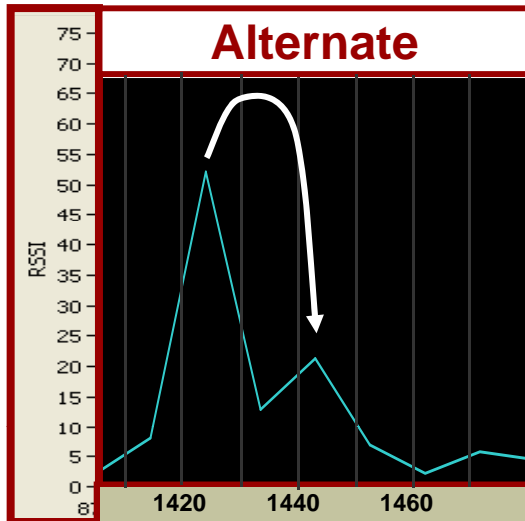
Competitive Solution



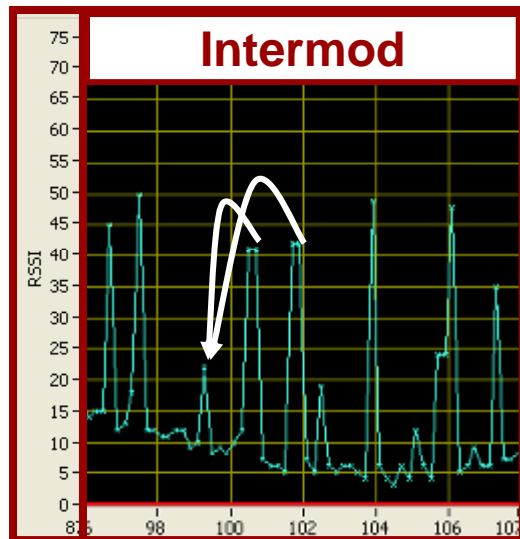
Si473x



Unmatched Interference Performance



- ◆ Si473x picks up weak stations in crowded AM and FM environments
 - “Selectivity” is ability to receive weak signals with large adjacent (one channel offset) or alternate (two channel offset) blockers
 - Leading adjacent/alternate channel selectivity
 - FM selectivity 15-25 dB better than competition
 - AM selectivity 20-25 dB better than competition



- ◆ Si473x has best FM overload performance
 - Superior linearity (IP3) avoids inter-modulation
 - Competition is 13-25 dB worse
 - Superior sensitivity in strong signal environments

Features—Si4734/35 AM/FM/SW/LW Receiver

- ◆ Market-leading audio performance
 - Sensitivity and selectivity
 - High performance AM/FM, short wave (SW) and long wave (LW) seek
- ◆ Highly programmable settings
 - Softmute, blend and adjustable channel filters for optimal audio quality
- ◆ Extensive options
 - FM stereo band (76 to 108 MHz)
 - FM mono band (64 to 76 MHz) (**Si4734/35 only**)
 - RDS/RBDS decoder (**Si4731/35/37/39 only**)
 - Digital audio output (**Si4731/35/37/39 only**)
- ◆ AM antenna flexibility enabling smaller antennas, better reception
- ◆ Simple command-based interface
- ◆ EN55020/22 compliant



Features—Si473x AM/FM/WB Receiver

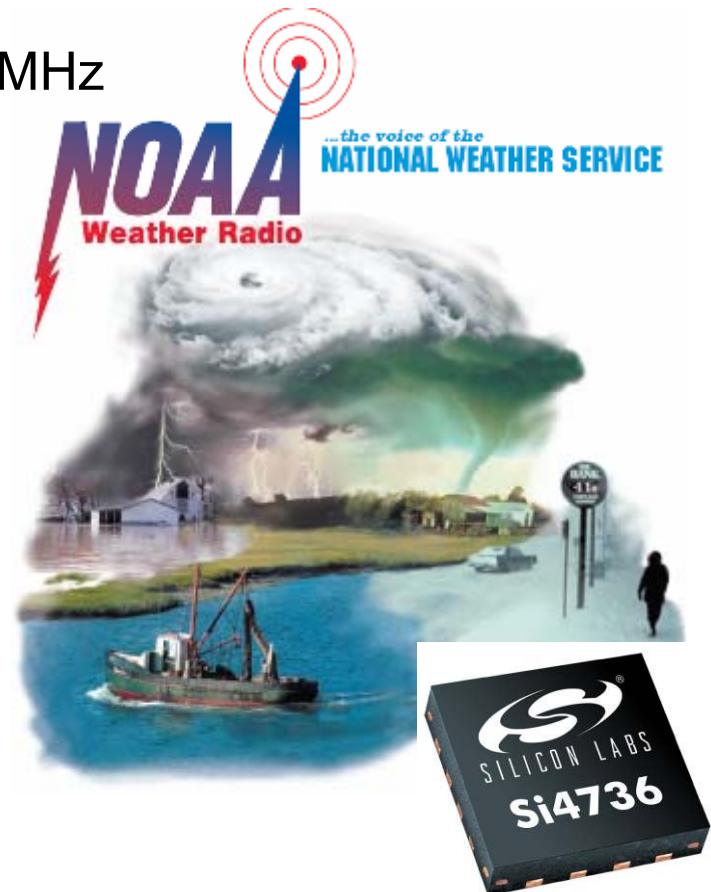
◆ Si473x AM/FM/WB receiver

- Narrow band FM receiver 162.4–162.55 MHz (all 7 WB channels)
- Worldwide FM stereo receiver
- Worldwide AM receiver (Si4736/37)
- FM RDS/RBDS decoder (Si4737/39)
- 1050 Hz alert tone detection: automatic wake-up during hazards

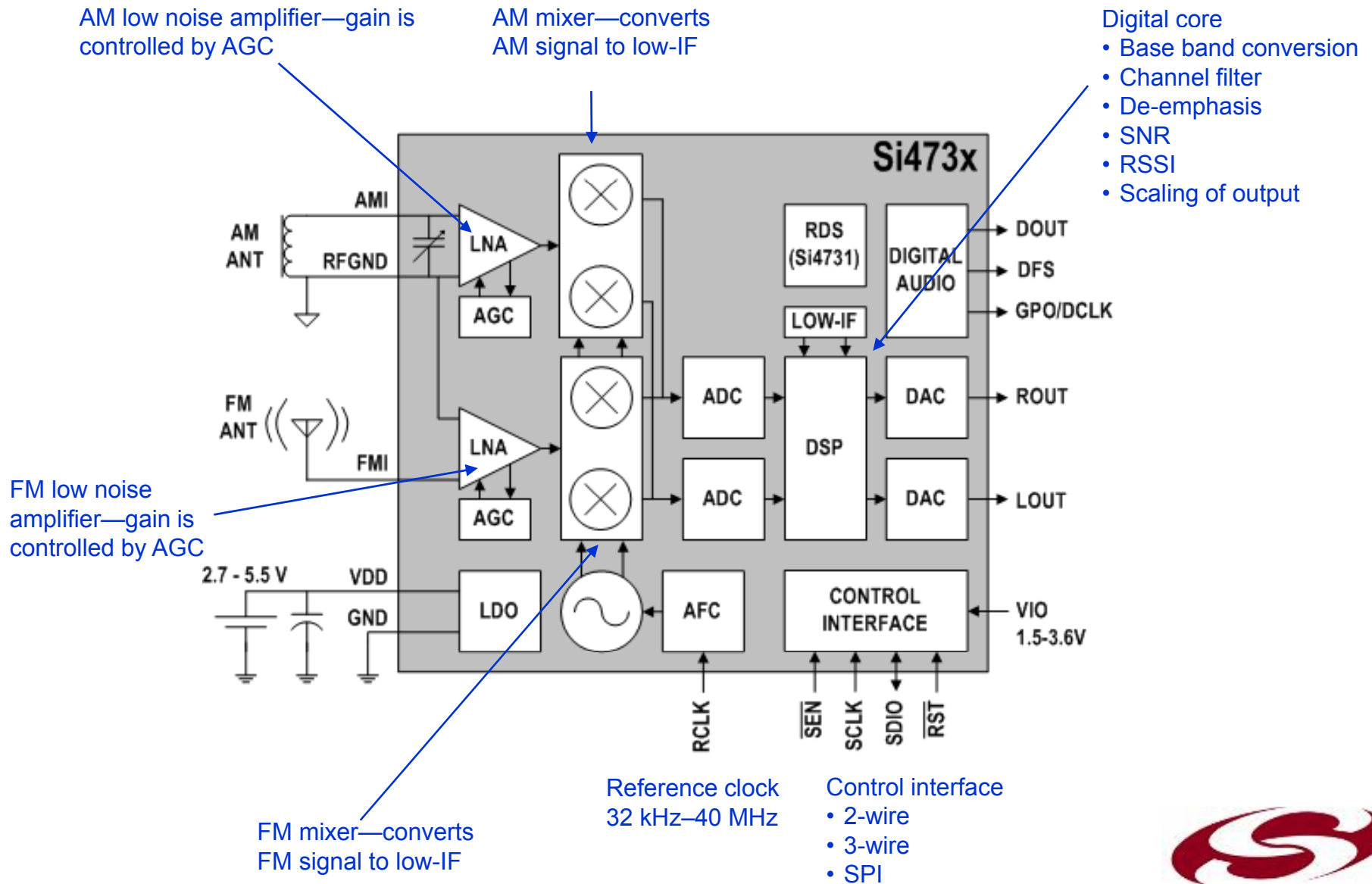
◆ Si4707 Weather Band + SAME decoder

◆ Patented digital low-IF architecture

- Proven technology from highly successful Si47xx product family
- Digital architecture allows for high integration



Si473x Block Diagram

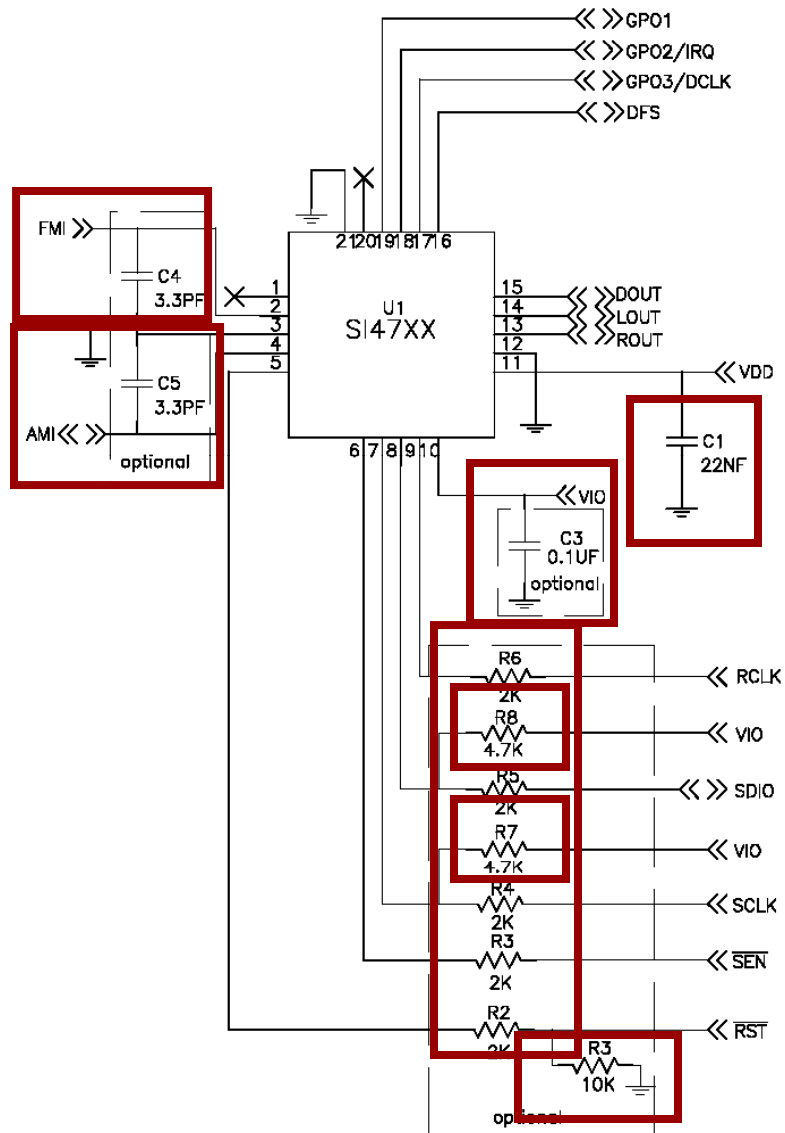




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Design and Layout Guidelines

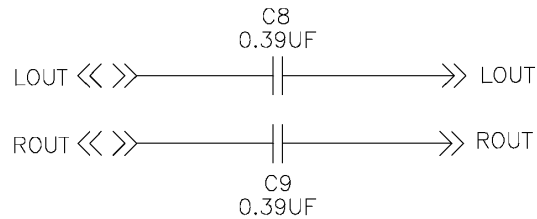
Si473x—Schematic (1 of 3)



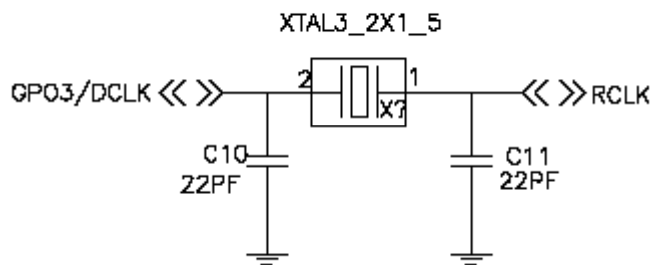
- ◆ **C1 (22nF)** – VD/VDD supply bypass cap (required)
- ◆ **C3 (100nF)** – VIO supply bypass cap (optional)
- ◆ **C4 (2-5pF)** – VCO filter for FMI pin (optional)
- ◆ **C5 (2-5pF)** – VCO filter for AMI pin (optional)
- ◆ **R2-R6 (25Ω – 2kΩ)** – digital noise suppression (optional)
- ◆ **R3 (10kΩ)** – RST~ pull down for powerup sequencing (optional)
- ◆ **R7,R8 (4.7kΩ)** – I²C pullups (optional)

Si473x—Schematic (2 of 3)

SI47XX ANALOG AUDIO OUT OPTION



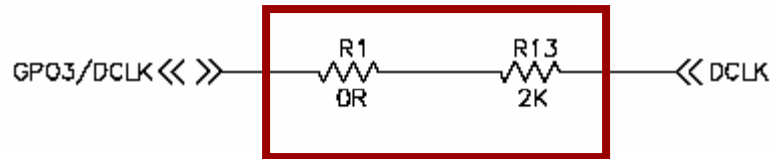
SI47XX CRYSTAL OPTION



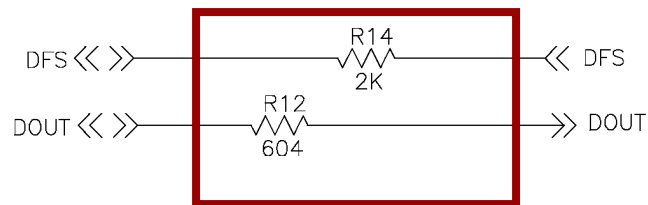
- C8,C9 (0.39uF) – ac coupling
- X1 (32.768 kHz) – crystal (optional)
- C10,C12 (22pF) – load caps (optional)

Si473x—Schematic (3 of 3)

SI47XX DIGITAL AUDIO OPTION



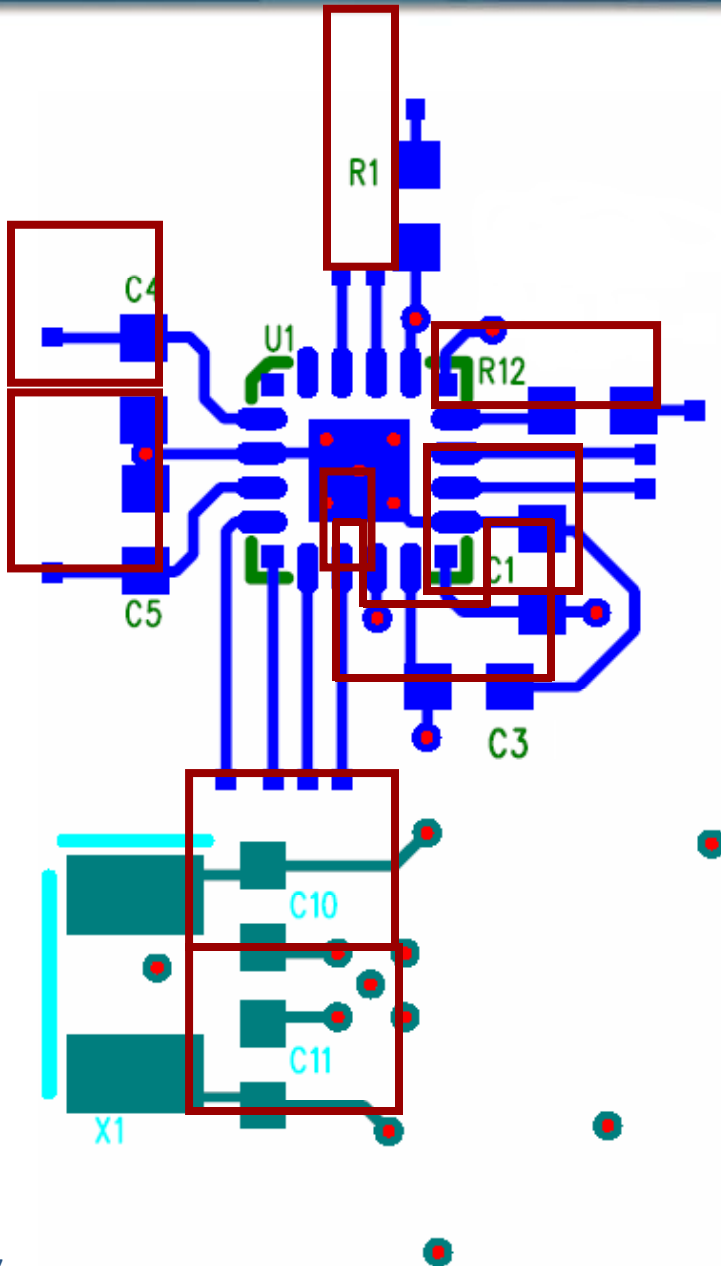
SI473X DIGITAL AUDIO OUT OPTION



◆ Si473x (digital out)

- **R1 (0Ω)** – jumper to select digital out (required only if supporting universal design)
- **R12 (604Ω)** – DOUT current limiter
- **R13,R14 (25Ω – 2kΩ)** – DCLK, DFS current limiter

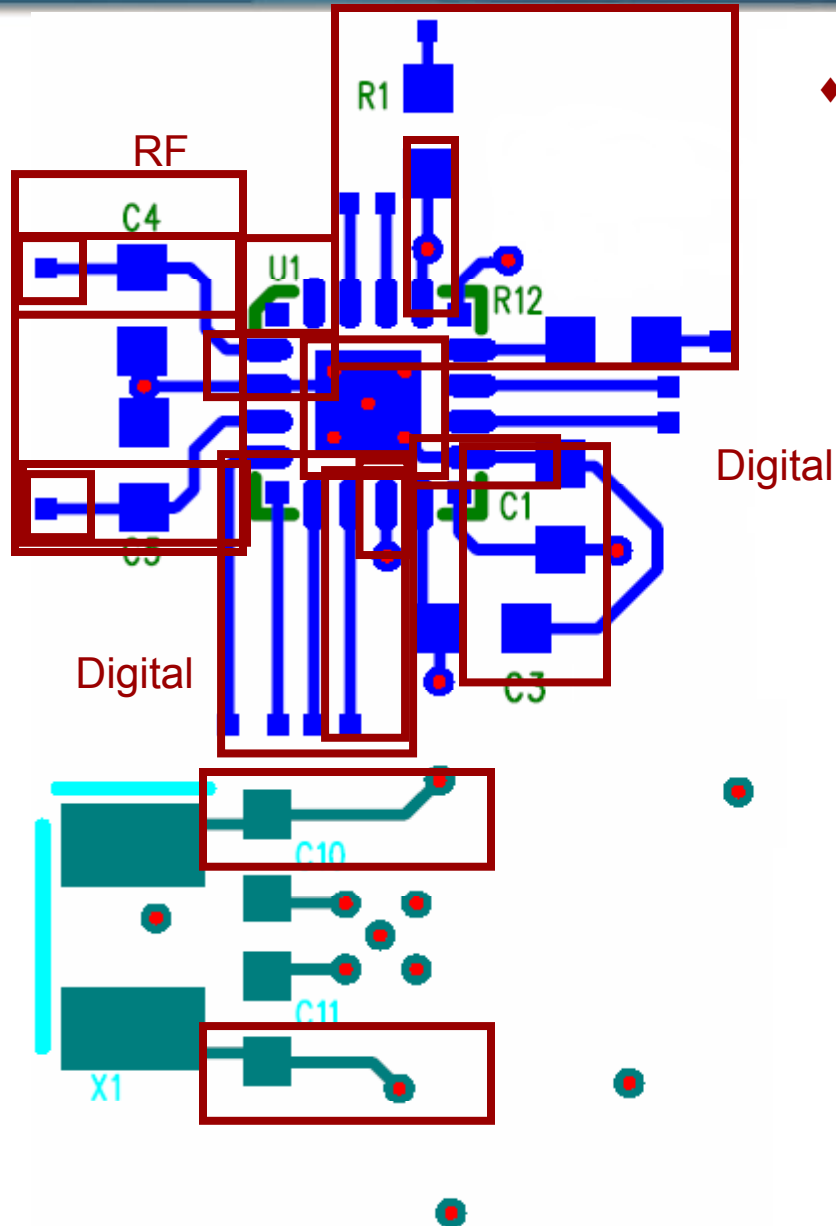
Si473x—Layout (1 of 2)



◆ Placement

- **C1** – close to VDD pin and GND pin, between power VIA and Si47xx (decoupling)
- **C3** – close to VIO pin and GND pin, between power VIA and Si47xx (decoupling)
- **C4** – close to FMI pin and GND pin (filtering)
- **C5** – close to AMI pin and GND pin (filtering)
- **R1** – close to GPO3/DCLK pin (minimize coupling)
- **R12** – close to DOUT pin (series termination)
- **X1/C10/C11** – close to GPO3/DCLK and RCLK pins (minimize coupling)

Si473x—Layout (2 of 2)



◆ Routing

- C1 GND connection at GND pin 12 and pin 12 connection to GND pad (no VIA) (decoupling)
- C3 GND connection at C1 GND (no VIA) (decoupling)
- Keep RCLK and SDIO away from each other (minimize coupling)
- Keep digital traces away from RF (minimize coupling)
- Minimize RF trace length to antenna (minimize capacitance and coupling)
- Keep FMI VIA (if needed) and AMI VIA (if needed) such that cap is between VIA and Si47xx (filtering)
- Keep all traces away from VCO (minimize coupling)
- Minimize crystal trace lengths (minimize coupling)
- Route RFGND to the GND pad
- GND plane should be directly under the Si47xx and multiple VIAs should connect it to the GND pad (minimize coupling)
- Power should be routed on traces (decoupling)
- No traces should be routed between the Si47xx and GND plane (minimize coupling)



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Support Resources

Website Support: www.silabs.com/Audio

Support Links

Registration

The screenshot shows the Silicon Labs website interface. At the top left is the Silicon Labs logo and navigation links: + Products, + Applications, + Support, + Buy or Sample. A search bar is located at the top right with options for 'Keyword Search' and 'Full Part Number Search'. The breadcrumb trail reads: Silicon Labs > Products > Audio/Video > AM/FM, Short Wave, Long Wave, Weather Band Receivers. The main content area features a sidebar on the left under 'Audio/Video' with a list of product models: Si4707, Si4730/31, Si4734/35, Si4736/37, and Si4738/39. The main content area is titled 'AM/FM/SW/LW/WB Radio Receivers' and includes a 'Product Matrix' button. Below the title is a descriptive paragraph about the Si47xx devices and a list of links for specific receiver models. On the right side, there are sections for 'Resources' (Documentation and Education Center) and 'Get More From This Site' (Create your profile, Login, and Product Pricing and Availability).

Product Derivative Information

Documentation

Buy or Sample



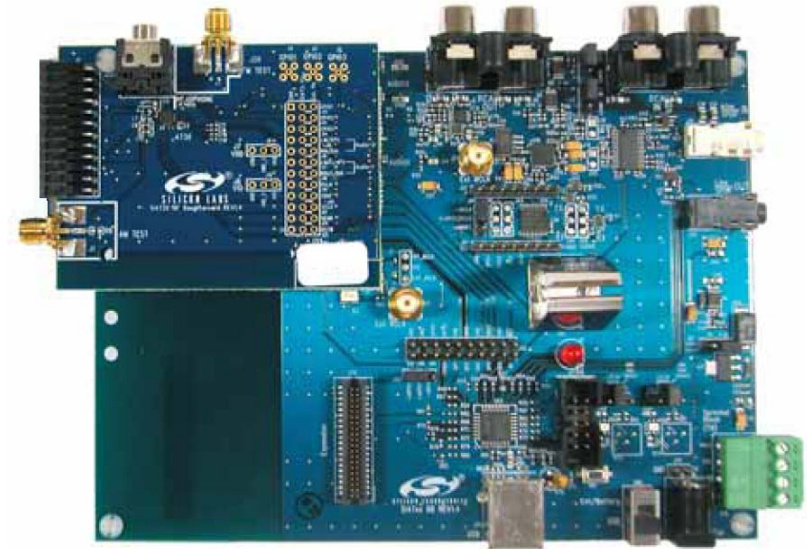
Si4735-EVB for Product Development

◆ Features

- AM/FM/LW/SW support
- PC interface for configuration, debugging and datalogging
- Test report provided
- Digital audio interface
- Multiple antenna support

◆ Kit Contents

- EVB (as shown)
- Ferrite antennas
- Airloop antenna
- Whip antenna
- USB, RCA cables and adapters
- Headphones
- 9 V battery
- CD with GUI and documentation



Part #: Si4735-EVB

This Development Kit retails
for **\$150.00 USD**



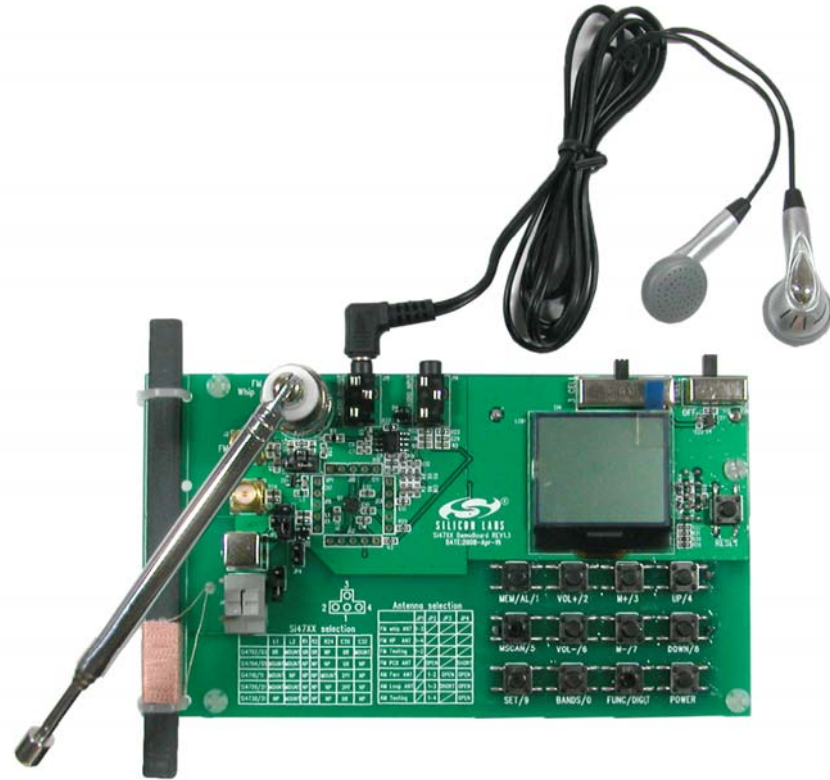
Si4731-DEMO for Product Demonstration

◆ Features

- AM/FM support
- LCD + keypad user interface
- 1 battery (with C8051F930 MCU boost converter) or 3 battery operation
- Multiple antenna support

◆ Kit Contents

- EVB (as shown)
- Whip antenna
- Headphones
- (3) AAA batteries and (1) AA battery
- CD with documentation



Part #: Si4731-DEMO

This Demonstration Kit retails
for **\$50.00 USD**



Get Started Today!

◆ Download the Audio Solutions Guide

➤ www.silabs.com/Audio

◆ Free silicon samples

➤ www.silabs.com/buysample

◆ Development tools from your local distributor

➤ www.silabs.com/buysample

◆ Orderable part numbers

➤ Development kit: Si4735-EVB

➤ Demonstration kit: Si4730-DEMO



Broadcast Audio Solutions

HIGHLY INTEGRATED AND EASY TO IMPLEMENT
SINGLE-CHIP SOLUTIONS

FEATURES

- Worldwide FM band support (76–108 MHz)
- Worldwide AM band support (520–1720 kHz)
- Requires only 2 external components
- Frequency synthesizer with integrated VCO
- Advanced AM/FM seek tuning
- PCB trace/integrated antenna support with self-calibrated capacitor tuning for FM receive and transmit
- Excellent receive overload immunity
- Adaptive noise suppression
- Programmable audio characteristics
- Digital stereo modulator/demodulator
- Programmable transmit level
- Line-level analog input/output
- RDS/RBDS receive and transmit decoder/encoder
- Digital gain compression
- Digital audio interface
- Programmable reference clock
- Integrated LDO regulator
- Pb-free and RoHS compliant

PRODUCT DESCRIPTION

Silicon Laboratories' family of Si47xx broadcast audio solutions are the industry's first to leverage digital integration and 100% CMOS process technology, resulting in a completely integrated solution that requires only two external components and less than 1.0 mm² of board space. Offering unmatched integration, the Si47xx family enables FM transmission and AM and FM radio reception in any device, especially those where board space, low power consumption, performance, and ease of use are essential. Leveraging Silicon Labs' proven digital low intermediate frequency (low-IF) receiver architecture and frequency synthesizer technology, the Si47xx family delivers superior RF performance and interference rejection. Digital signal processing is utilized to provide optimum sound quality under varying reception conditions. The high level of integration and simplified bill of materials (BOM) enable on-board production testing, increased quality, and improved manufacturing. The Si47xx family also uses a streamlined programming model, which further reduces development time. Having shipped worldwide, the Si47xx family are proven products ready to be integrated into any portable device.

MOST INNOVATIVE BROADCAST SOLUTIONS

- First AM/FM digital CMOS solution family
- First, and smallest, FM transceiver (receive and transmit)
- First to support small integrated antenna for FM receive and transmit
- First AM/FM IC with RDS
- First AM/FM IC with no manual alignment required
- First footprint compatible family of broadcast audio products
- Smallest footprint
- Highest level of integration

APPLICATIONS

- Cellular handsets and accessories
- Portable media players and accessories
- Consumer electronics
- Navigation devices
- Satellite radios
- AM/FM portable and countertop radios

SOLUTIONS GUIDE

HIGHLY INTEGRATED
BEST-IN-CLASS PERFORMANCE
EASIEST TO DESIGN


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