Freescale Set-Top Box Multimedia Products (FC108)

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Product Applications

- Cable Modem
- Cable Modem/VoIP Terminal
- Analog and Digital CATV Set-Top Boxes
- CATV Media Gateway
- Computer TV add-in cards
- Digital Terrestrial TV receivers
- Analog Terrestrial TV receivers
- Modules
Multimedia Products Are In These Markets

Freescale Products

- Modulators
  - MC44Bx373/374
  - 375, 380
- Stereo Encoder
  - MC44C401,2
- Silicon Tuner
  - MC44S803

Module Suppliers

Cable STB / Model
- DBS (Satellite STB)
- Terrestrial/Hybrid STB
- Consumer Devices

FSL Multimedia Products In Module Suppliers and Box Builders
Growth in Digital STB markets (2004-09)

- 16% CAGR
- Unit shipments doubling from 46M to 97.4M

*Source: Semico Research Corp*
ASPO Multimedia Products Roadmap

**Silicon Tuners**
80x Family
- Single-chip Broadband Tuners
- Dual-conversion Architecture
- Integrated IF AGC amplifiers
- I2C or SPI interface
- Low power consumption (< 850mW)
- Cable Labs Certified for DOCSIS 2.0 Apps.

**DeModulator**
Integrated ADCs
Compliant to the entire DVB-T, ETSI 300 744 standard
Excellent Single Frequency Network Perf

**RF Modulators**
37x Family
- UHF-VHF (Agile) & VHF (Ch 3-4) versions
- Multi-Standard, NTSC, PAL & SECAM support
- Integrated VCOs
- Programmable I2C bus
- 5V Single Supply operation
- 3.3V Single Supply Next Generation CMOS

**Stereo Encoders**
40x Family
- Integrated A/D input and D/A output circuitry
- CEX™ digital audio processing engine
- Dolby® Pro Logic® surround sound and Macrovision™ compatible
- Simple, passive interface to Freescale 37x Family RF Modulators

MC44C800
MC44BC374
MC44BC374
MC44BS374
MC44BS373
MC44BC374
MC44C400
MC44C401
MC44C402
MC44C402F
MC44CM373/4
MC44BC375
MC44C801
MC44S803
SC Cable Tuner
QAM/VSB Demod
DVB-T Demodulator
DVB-T RF Tuner
Single Chip Tuner/DeMod

2002  2003  2004  2005  2006  2007  2008/9
Modulators

NTSC, PAL & SECAM
What Are RF Modulators & Why Are They Needed?

• RF Modulators convert audio and video signals into RF, suitable for reception by a standard UHF TV Tuner
  ▪ Similar function to a TV transmitter, converting A/V to an RF channel

• Freescale’s Modulators are PLL tuned with integrated VCOs and cover UHF/VHF TV bands

• One cable connection of AV equipment to televisions
RF Modulators Strategy

- **Strategy**
  - Maintain **Market Leadership**!
  - Products: MC44BS373/374 UHF-VHF Modulators; MC44BC375 VHF
  - Dominate the **Low Voltage Market Segment** (5V)
  - Enablement for Stereo Encoder
  - Introduce **CMOS Modulator** to maintain Price/Performance leadership position (373/374)
    - 16 pin SOIC package
    - Functionally equivalent to Freescale’s BiCMOS device
    - 3.3V operation
RF Modulators

• **Features:**
  - Multi-Standard, NTSC, PAL & SECAM
  - PLL tuning over full UHF range
  - **Integrated programmable UHF oscillator**
  - Programmable I2C bus
  - **5V operation (no 30V supply needed)**
  - Various Output levels ranging from > 76dBµV to 82dBµV

• **Benefits:**
  - Simple layout and manufacturing (no tuned components, fewer critical RF paths)
    - Easy integration on main board
    - Low board space and component count
  - Low system power consumption
  - Short time-to-market
  - Simplified sourcing
    (no special components)

• **Applications:**
  - Cable Set Top Boxes
  - VCRs
  - DVD Player/Recorders
  - A/V Redistribution Products
MC44BS374C vs. Competition

**Actual Schematics**

### Ext Components

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<th>TA1297AFN</th>
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<tr>
<td><strong>Total</strong></td>
<td><strong>15</strong></td>
<td><strong>34</strong></td>
<td><strong>19</strong></td>
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</table>

**Competition:**
- Ext pre-emphasis netwrk
- Ext UHF tank- varactors+inductor
- 2x External Components
- 33V supply vs 5V w/ FSL
- 393mW vs 260mW w/ FSL
CMOS RF Modulators
MC44CM373/374

• Features:
  - Functionally equivalent to existing (BiCMOS) modulators
    > Same Features & Performance
  - 3.3V Power Supply
  - 16 pin SOIC
  - I²C bus address options

• Benefits:
  - Mainstream CMOS process
  - More economical than BiCMOS or Bipolar

• Availability
  - Planned November 2006 Samples
  - Planned March 2007 Production Release
Functional Block Diagram **CMOS Modulator**

- **16 Pin package**
  - SOIC Pb-Free
- **Internal Programmable PLL**
- **Secondary I²C version** available to allow multiple modulators on board
Stereo Encoders
MTS and NICAM
What Are Stereo Encoders & Why Are They Needed?

• FSL’s stereo encoder is a single chip, Multi-Channel Television Sound (MTS) stereo audio encoder

• The job of a stereo encoder is to allow consumers to enjoy Hi-Fi stereo and surround sound via a single wire F-Connection to their TV

• The stereo encoder complements Freescale’s RF modulator product family by providing a simple, passive interface to the RF modulator IC.
  - Together these devices provide a complete solution for stereo audio over a single RF coaxial cable
Stereo Encoder Product Strategy

Strategy

• Products: MC44C401, MC44C402A
• Tactics: Provide market with a unique technology (stereo encoding, BTSC compatible) enabling stereo surround sound over an RF Coax cable
• Provide market with product portfolio (performance based)
• Driven multi-room set-top box makers
• Long Range: embed modulator, cost reduce for large DVD-R market
• NICAM stereo encoder acceptance
MTS Stereo Encoder

• Features:
  - Integrated A/D input and D/A output circuitry with CEX™ digital audio processing engine
  - **Dolby® Pro Logic® surround sound and Macrovision™ compatible**
  - Simple, passive interface to Freescale 37x family RF modulators
  - **Small footprint 32-pin “lead-free” TQFP package**

• Benefits:
  - Preservation of original Dolby® Pro Logic® surround sound fidelity
  - System performance not impacted by copy protection technologies

• Applications:
  - Set Top Boxes, VCRs, DVD player/recorders, game consoles

• Status: **Production Now**
Low-Cost “Home Media Gateway” Solution

Stereo Encoder + RF Modulator Eliminates ‘Slave’ STBs and Utilizes Existing Home Coax (Cable) Networks

- Twin-tuner STB
- RF Coaxial
- RCA Composite
- IR Remote
- TV1 Out
- TV2 Out
- Broadband In
- Secondary Viewing Area
- Primary Viewing Area
- RF Coaxial (Stereo)
MC44C402 Typical Application Circuit
Product Price/Performance Portfolio

- **MC44C401**
  - Low cost, *value leader*

- **MC44C402A**
  - Higher Performance at a competitive price
  - Improved audio performance

- **MC44C402F**
  - Highest system performance
  - *New Architecture*
  - Integrate FM modulator on stereo encoder to eliminate SNR limit imposed by modulator
NICAM Encoder (Future Product)

• Customers/Markets
  ▪ Target European and Asian markets
    > Home gateway and dual STB
    > DVD, Cable STB, VCR, DBS

• Integrated NICAM encoder offers
  ▪ World standard broadcast stereo solution
    > NICAM is standard in Europe and Asia (except Japan)
  ▪ High Integration
    > No External ADC or DAC
    > Internal QPSK modulator
  ▪ Single 3.3V power supply
Nicam Stereo Encoder

**Features:**
- Based on existing BTSC Encoder
- Integrated A/D input and D/A output circuitry
- Digital Audio Processing Engine
- **Integrated QPSK Modulator**
- Simple, passive interface to Freescale’s 37x family of RF Modulators
- 32-pin QFN package

**Benefits:**
- HI-FI stereo sound on most Televisions without external decoder
- Enables lower system component count, smaller board size, and significantly lowers overall system cost
- **Addresses stereo needs for use in Asia and Europe**
Silicon Tuner
What Are Silicon Tuners & Why Are They Needed?

• Silicon tuners are integrated circuits that can receive Audio/Video programming via RF broadcast and convert into a lower, more “workable” frequency
  - RF to intermediate frequency (IF)

• The job of a tuner is to select a single channel from the available channels on the broadcast
  - Broadcast can be over-the-air (terrestrial) or cable
Strategy

- **Products:** MC44S803 (Gen3)
- **Strategy:** Leverage Unique IP position
- **Tactics:** Differentiate with all CMOS high performance dual-conversion tuner (**Low Power!**)
  - Supports smaller form factor applications
  - Drives high performance
  - Supports low voltage tuner applications
MC44S803 Silicon Tuner (Gen 3) Dual Conversion Silicon Solution

- Features:
  - Variable gain LNA
  - Fully integrated VCOs
  - Flexible reference oscillator circuit
  - I²C or SPI interface
  - Internal regulators
  - Programmable power down modes
  - Internal self diagnostic circuits
  - Integrated IF AGC amplifier
  - Low power consumption (~650mW - 850mW)
  - 64-pin “Pb-free” QFN package
MC44S803 Silicon Tuner (Gen 3) Dual Conversion Silicon Solution (cont)

- **Benefits:**
  - Minimum CTB, CSO of -63 dBC, and Xmod better than -60 dBC
  - Typical noise figure of 7.0 dB
  - Phase noise @ 10 KHz of -95 dBC/Hz
  - Single 3.3V supply

- **Applications:**
  - Analog Digital STB
  - Integrated DTV
  - Computer TV Tuner Cards
  - Home DVD-R, DVR, PVR

- **Status:**
  - Samples NOW!
  - Production Ramp September 2006
Single Conversion Tuner vs. Freescale MC44S803

Tracking filters, manually aligned. Labor Intensive!

Based on FSL MC44S803 Silicon Tuner Solution
Freescale Design Aids – **MC44S803EVK**

- Reference design and evaluation board
- Gerber files and **schematics** for reference design
- Windows based **software** to control all tuner parameters
- Tuner **device driver** source code in C
- App notes/documentation CD

```c
/******************************************************************************
* Function Name: tune_mc44s803
* Description:
*   This routine tunes the MC44S803 to the desired channel by setting the
*   first and second LOs, and then digtune() to initiate the automatic PLL
*   fine tuning state machine.
* Parameters:
*   freq: an integer number representing the center frequency of
*         the desired channel, in Hz.
* Return values:
*   PASS: Tuner is set.
*   FAIL: An I2C error occurred, see i2c error codes for details.
******************************************************************************
int tune_mc44s803 (int input_freq)
{
  ...
}"
```
MC44S803 Evaluation Board

• The circuit inside the shield is the actual application

• Everything outside the shield is support circuitry for the evaluation board
MC44S803: Windows Based Programmer
/*******************************************************/
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int tune_mc44s803 (int input_freq)
{
  ...

  • Modify header file with system constraints

  • Add I2C driver.
Thank you!
Freescale Technology Forum
Design Freedom.