Sub-track I –
Smart Mobility Presentation
ST solutions for smart cockpit tuners / GNSS / audio amplifiers

Johnson Wang
Technical Marketing Manager
STMicroelectronics
1. Smart cockpit system overview
2. Tuner presentation
3. GNSS presentation
4. Automotive audio solutions
Smart cockpit system overview
Smart cockpit system

**Power supply**
- ST proposal for 1st stage power supply
- ST cooperate to develop PMIC with SoC company

**Tuner**
- ST SDR solution for SoC which support HSI
- Connect tuner box by USB, if SoC cannot support HSI

**GNSS**
- TESEO-LIV3F or TESEO-VIC3DA
- ST High-precision navigation is also ready for cockpit trend

**MCU**
- ST MCU products and roadmap are available

**Sensor**
- ASM330 6-axis motion sensors

**Amplifier**
- Class D solution
  - Along with increasing speaker power trend (>50W) and weight loss requirements. Class D will replace Class A/B in ~3 years.
Tuner presentation
Terrestrial tuner roadmap

**Integrated AM/FM Radio Receiver**
- **STAR**: Single and Dual AM/FM
- **STAR-Lite**: Single Ch AM/FM
- **MSR1-B**: Multi Ch Multi STD

**Digital CoProcessor**

**Multi-Standard Front End**
- **DOT**: Single and Dual Ch Multi STD

**Transition to Software-Defined Radio Architectures**
- **ST RF (STAR/DOT) + SoC**

**Years**:
- 2016
- 2017
- 2018
- …
- 2021
- 2022
- 2023
- 2024
- 2025
CMOS tuner family

**ST Advanced Radio Receiver (STAR)**

- Dual channel
- AM / FM Phase Diversity integrated
- DAB / AM / FM IQ data output

- Single channel
- AM / FM integrated
- AM / FM IQ data output

- Single channel
- AM / FM integrated

**Digital Output Tuners (DOT)**

- Dual channel
- STA710EC: DAB / AM / FM IQ output
- STA710AEC: AM / FM IQ output

- Single channel
- STA709: DAB / AM / FM IQ data output
- STA709A: AM / FM IQ data output

- All variants are pin-to-pin and API compatible
Comparison:
- Smaller chip size and PCB area
- Lower BOM cost
- No embedded audio processing

<table>
<thead>
<tr>
<th>Component</th>
<th>TDA7707</th>
<th>D3</th>
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<tr>
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<td>15</td>
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<tr>
<td>C</td>
<td>34</td>
<td>74</td>
</tr>
<tr>
<td>L</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>BLM</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Xtal</td>
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<td>1</td>
</tr>
<tr>
<td>T</td>
<td>0</td>
<td>3</td>
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### TDA7708 vs. Lithio

- 對照表:
  - 更小的PCB面積
  - 更低的BOM成本
  - 不需要大的外部線圈
  - 不需要大電解電容
  - 不需要射頻變壓器
  - 無需提高數位介面的驅動能力

<table>
<thead>
<tr>
<th>Component</th>
<th>Lithio</th>
<th>TDA7708</th>
<th>Note</th>
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<tr>
<td>Resistor</td>
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<td>6</td>
<td></td>
</tr>
<tr>
<td>Inductor</td>
<td>5</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Capacitor</td>
<td>27</td>
<td>20</td>
<td>Lithio 需要一個額外的100uF電解電容</td>
</tr>
<tr>
<td>Quartz</td>
<td>1</td>
<td>1</td>
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<tr>
<td>BLM</td>
<td>0</td>
<td>2</td>
<td>用於電源濾波</td>
</tr>
<tr>
<td>Transistor</td>
<td>2</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>RF Transformer</td>
<td>1</td>
<td>0</td>
<td>配合高性能應用， Lithio需要外加一個接收變壓器</td>
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</tbody>
</table>
MSR1-B key features

MSR1-B open market product variants

Features:
- **3 digital channel processing:**
  - DAB / HD / CDR / DRM(+), MRC FG
  - DAB / HD / CDR / DRM(+) BG
- AM / FM processing covered by STAR
- Seamless Service Following:
  - FM – DAB – DAB
- SPI control and data interface
- External radio control
- Scalability is managed by firmware
- Audio connectivity via various I2S (TDM) and SRCs

Product Variants:
- STA800B1 – DAB/DAB+
- STA880B2 – HD-Radio
- STA800B3 – DRM/DRM+
- STA800B4 – CDR

Package: FCTEBGA289
AM / FM PD / DAB MRC dual antenna EU

6 tuner channel – independent AM/FM & DAB BGS
GNSS presentation
ST is a pioneer for automotive GNSS receivers

High-precision GNSS

WW leading supplier for **GNSS positioning**

28% Market Share(∗)

- **Single-Band & Multi Constellation**
- **Multi-Band ASIL-B**

Sub-meter positioning

**Applications**

- **Infotainment GPS Navigation**
- **Autonomous Driving**
- **Enhanced Accuracy for ADAS**

(*) Based on Strategy Analytics Automotive Infotainment & Telematics
GNSS module target applications

- Module for leisure
- Module for logistics
- Module for fleet management
- Positioning
- Module for sports
- Module for pet tracking
Teseo-VIC3DA/D technical spec:

- Core: STA8089FGA* and ASM330LHH*
- LCC24 package (12.2 x 16.0 mm)
- Operating temperature: -40 to 85°C
- VCC/VCC_IO @ 3.3V
- VBAT in range 2.1 to 4.3V
- TCXO for fast TTFF and RTC X-TAL for superior accuracy
- Teseo dead-reckoning solution: Teseo-DRAW

*Teseo-VIC3DA version

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**Diagram Description:**

- **Teseo III – STA8089FGA**
  - GNSS Core & Subsystem
  - ARM-Core
  - ROM
  - RAM
  - 16 Mb Stacked Flash
- **ASM330LHH**
  - Connectivity
    - SPI
    - UART
    - I2C
- **Power Management**
  - SMPS
  - BKLDO
- **AntOn**
- **RF_In**
- **TCXO**
- **RTC-Xtal**
- **GND**
- **GND**
- **AntOff**
- **FWD**
- **Reserved**
- **VCC_RF**
- **nReset**
- **I2C_SDA**
- **I2C_SCL**
- **UART-TX**
- **UART-RX**
- **V_BAT**
- **VCC**
- **WakeUp**
- **Reserved**
- **IRQ**
- **Reserved**
- ***WHEESENT**
- **PPS**
- **Reserved**
- ** configured as PPS**
- **configured as Wake-Up**

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* Teseo-VIC3DA version
Teseo-LIV3FL technical specs

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<th>Items</th>
<th>Teseo-LIV3FL</th>
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<td>Core</td>
<td>STA8090WG</td>
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<tr>
<td>Package</td>
<td>LLC18 (10.0 x 9.8 mm)</td>
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<tr>
<td>Operating temperature</td>
<td>-40°, +85°C</td>
</tr>
<tr>
<td>VCC_IO</td>
<td>1.8V+/-5% and 3.3V +/-5%</td>
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<tr>
<td>VCC/VBAT</td>
<td>In range 1.71V to 4.2V</td>
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<tr>
<td>Built-in</td>
<td>TCXO and RTC X-tal</td>
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Teseo-LIV3F/R technical specs

<table>
<thead>
<tr>
<th>Items</th>
<th>Teseo-LIV3F/R</th>
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<td>Core</td>
<td>STA8090WG</td>
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<tr>
<td>Package</td>
<td>LLC18 (10.0 x 9.8 mm)</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>-40°, +85°C</td>
</tr>
<tr>
<td>VCC/VCC_IO</td>
<td>3.3V</td>
</tr>
<tr>
<td>VBAT</td>
<td>2.1V to 4.3V</td>
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<tr>
<td>Built-in</td>
<td>TCXO and RTC X-tal</td>
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**Teseo-LIV3**

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<td>10</td>
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<td>11</td>
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<tr>
<td>12</td>
<td>GND_RF</td>
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<td>13</td>
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<td>14</td>
<td>VCC_RF</td>
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<td>15</td>
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<td>16</td>
<td>I2C_SDA</td>
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<td>17</td>
<td>I2C_SCL</td>
<td>UART-TX</td>
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<td>18</td>
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<td>19</td>
<td>nRESET</td>
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<td>20</td>
<td>VCC</td>
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<td>21</td>
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<td>22</td>
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<td>UART-TX</td>
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<tr>
<td>27</td>
<td>GND</td>
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**Teseo III**

- GNSS Core & Subsystem
- ARM-Core
- ROM
- RAM
- Connectivity
- UART
- I2C
- Power Management
- SMPS
- BKLDO
- 16Mb Flash
- AntOn
- Wake-up
- Main supply (VCC)
- Back up supply (VBAT)
- I/O supply (VCC_IO)
### Teseo-LIV4F technical specs

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<td>GNSS bands</td>
<td>Simultaneously L1 &amp; L5</td>
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<td>VCC/VBAT</td>
<td>In range 3.0 V to 3.6V</td>
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<td>Built-in</td>
<td>LNA, SAW, TCXO and RTC X-tal</td>
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</table>

**Teseo-LIV4**

- **Items**: 10 GND_RF, 11 RF_IN, 12 GND_RF, 13 Reserved, 14 VCC_RF, 15 Reserved, 16 I2C_SDA, 17 I2C_SCL, 18 PRG, nRESET, VCC, Reserved, VBAT, WakeUP, PPS, UART-RX, UART-TX, GND

**Antenna**

- LNA, SAW, TCXO, RTC

**System**

- ARM-Core, ROM, RAM, UART, I2C, SMPS, BLKDO, Wake-up, Main supply (VCC), Back-up supply (VBAT), PPS

**Power Management**

- Connectivity

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*Image: STM Life.*
Automotive audio solutions
ST automotive audio amplifiers

#1 WW supplier in power amplifiers

>40% Market Share(*)

Intelligent Class AB
The most complete feature set including unique digital input class

Fully Digital Class-D
High performance & high efficiency

400 kHz & 2 MHz

Applications

Head Units and Clusters
Premium Sound
AVAS/EV sound
Emergency Calls

Market track record
> 3 Billion audio amplifiers for automotive sold to-date
> 150Mu high-efficiency audio power amplifiers shipped to date

Promoting ST leadership by innovation
Highest innovation rate for automotive applications: first on the market for highly efficient class AB audio, I2C diagnostic, digital input audio, and more

(*) Based on Strategy Analytics Automotive Infotainment & Telematics
**TDA7803A: digital class AB audio amplifier**

- **Mosfet output power stage**: 4x42W to 47W (4 Ω – 14.4V)
- **I2S or TDM (8 ch) digital input**
- **I2C bus**
- **Hardware further programming**
- **4 independent short circuit prot.**
- **2 ohm capable**

**Digital input**

**I2S bus / TDM**

**Class AB output**

**MASS PRODUCTION**

**I2S and TDM**

- Outstanding Audio Performances (SNR /DR, …) and complete immunity to any RF injection

- **High efficiency**
  - Very low power dissipation at very low system BOM cost (Highest class AB efficiency)

- **Start stop and high efficiency**

**EMC compliance**

- EMI compliance with international standards at no additional system cost

**TDA7802**

**TDA7803A**

**TDA7808**

**First generation I2S**

**Future of digital class AB**

**TDA7901**
<table>
<thead>
<tr>
<th>編號</th>
<th>通道</th>
<th>輸入</th>
<th>功放類</th>
<th>增益</th>
<th>工作電壓範圍</th>
<th>SSR（喇叭保護）</th>
<th>I²C診斷功能</th>
<th>高效率功能</th>
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<tr>
<td>TDA7803A</td>
<td>4</td>
<td>數位</td>
<td>AB</td>
<td>N.A.</td>
<td>6V to 18V</td>
<td>沒有</td>
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<td>頻比</td>
<td>AB</td>
<td>26/16dB</td>
<td>6V to 18V</td>
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## Performance comparison @14.4V
TDA75610S, TDA7803A vs competition class D

<table>
<thead>
<tr>
<th>Measurement</th>
<th>TDA75610S</th>
<th>TDA7803</th>
<th>2Mhz ClassD competition</th>
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<td>27 W</td>
<td>27 W</td>
<td>27 W</td>
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<tr>
<td>Output Power THD=10%, 2Ω</td>
<td>44 W</td>
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<td>45 W</td>
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<td>THD P=4W, f=1kHz, 4Ω</td>
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<td>0.015 %</td>
<td>0.03 %</td>
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<td>175 mA</td>
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<td>Noise A-wtd</td>
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<td>27 μV</td>
<td>55 μV</td>
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<td>Overcurrent Protection</td>
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<td>10 A</td>
<td>9 A</td>
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<td>1 °C/W</td>
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<td>YES</td>
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Our technology starts with You