



### General Description

The SWA13-TX module is part of a family of products that represents a new level of system integration offering customers fast time to market with a point-to-point or point-to-multi-point, mono, or stereo, wireless connections. These modules are optimized for low-cost, high-quality and ease-of-use.

The SWA13-TX module serves as the sender in point-to-multipoint wireless audio networks.

The module incorporates Avnera's proprietary wireless audio protocol, designed from the ground up specifically for audio. It features low fixed latency, uncompressed CD quality mono or stereo audio, superior interference immunity and industry leading coexistence with WiFi – even at close proximity to a WiFi device.

The SWA13-TX module integrates all features necessary to complete a wireless stereo or mono link, including AV6301 Wireless Audio Sender Chip, printed diversity antenna, flash memory, interface connector and all passive components. Just supply 5 Volts and an I2S interface and you are ready to create a wireless audio link.

The module measures just 26 x 60 x 3.5 mm and is provided with a 24 pin FPC connector or pin header for connection to the system board.

The module is certified to FCC and CE standards.



### Applications

- ✓ Wireless Subwoofers
- ✓ Stereo Wireless Rear Speakers
- ✓ Soundbar / Audio Video Receiver / BluRay
- ✓ Mono/Stereo Audio Channel Transmission

### Features

- ✓ Audio Interfaces
  - ✓ I2S Digital Input interface with >94dB end-to-end digital audio path
- ✓ > 15m range
- ✓ Frequency range: 2.4 GHz ISM band, continuous dynamic frequency selection
- ✓ Forward error correction coding, error detection, and audio-specific error concealment
- ✓ Dual printed PCB diversity antennas for multipath and fading mitigation
- ✓ Auto-search/synch and dynamic channel selection
- ✓ Low and fixed latency <17 ms
- ✓ 24 pin FPC or pin header connector
- ✓ Sample rate converter:
- ✓ Over-the-air firmware update capability
- ✓ Customizable firmware for simple,
- ✓ General purpose over-the-air (OTA) serial interface:
  - ✓ > 2 kbps, bi-directional, full duplex
  - ✓ Support for amplifier control data, meta-data, and remote control commands

## 1. SWA13-TX Functional

The SWA13-TX module is available in a single incarnation; digital input transmitter module. There are two I2S ports, a separate I2S port for digital audio input and an I2S out port is available for future applications. I2S may be configured to be a master or a slave. In addition, MCLK can be generated from the module, or input to the module as required by the system application.

錯誤! 找不到參照來源。 shows the block diagram of the SWA13-TX module.

The highly integrated nature of the AV6301 transceiver IC results in few external components being required for the SWA13 module design. 2 PCB antennas are used to achieve increased range through antenna diversity. The simple RF path consists only of the antennas, associated tuning components, an RF switch and a balun connected to the AV6301 IC. A 16MHz crystal generates the AV6301 system clock signal used as the basis for all RF and digital audio signals.

A 2Mb flash memory stores the factory based firmware, as well as firmware upgrade images and configuration parameters. The module firmware enables upgrades to be performed by the I2C slave interface or over-the-air. The module can be controlled from an external host device via the I2C interface. The I2C master port allows the module to control other system devices such without having to add another MCU to the product design. Up to a maximum of 17 GPIOs are supported with the SWA13 module including I2C and I2S signals. This large number of GPIOs can be leveraged to implement low cost sub-woofer designs as outlined below.

The SWA13-TX module offers both standard latency and low-latency firmware with different over the air sample rate. While the standard 22.2KSps over the air sample rate optimizes audio quality and WiFi co-existence performance; Lower audio latency can be achieved by using the low-latency 44.4KSps over the air sample rate.

**Multi-Client Implementation:****1.1. SWA13-TX Module Connections**

| Signal Type     | Description                                                                                                                                                                                                                                                                                                                                                                                          |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| +5V Supply      | Single +5V +/-10% supply rail to the module                                                                                                                                                                                                                                                                                                                                                          |
| Reset           | Active low reset input. This pin is driven from an open collector/drain device such that it can pull to ground for the active reset state but, when released, must go to a high impedance state. If this input is driven high the internal reset circuit on the module will not operate correctly.                                                                                                   |
| I2S In Port     | The I2S input port can be configured as a master or slave. Consequently BCLK and WCLK can be either inputs or outputs. In addition, MCLK can be generated by the module on pin 16, or used as an input. Typically, as the AV6301 IC contains a sample rate converter, MCLK is not required to be supplied to the module when it is an I2S slave. CMOS 3.3 logic levels are used for all I2S signals. |
| I2C Slave Port  | The I2C slave port is used for external host communication and during module test. It is assumed that external pull up resistors are connected at the I2C master communicating with the module.                                                                                                                                                                                                      |
| I2C Master Port | The I2C master port is used to communicate with external audio devices such as a sub-woofer amplifier. The SDA and SCL signal lines have pull ups internal to the module.                                                                                                                                                                                                                            |
| GPIOs           | 3.3V CMOS logic level GPIOs available to connect to other devices, or to use as UI supporting GPIOs for LED and button support. All supported GPIOs can be configured as inputs or outputs.                                                                                                                                                                                                          |

## 2. SWA13-TX Connector Information

Table 1-1 SWA13-TX Connector Information

| No | Pin Name           | I/O | AV6301       | Pin | Pin Description                                           |
|----|--------------------|-----|--------------|-----|-----------------------------------------------------------|
| 1  | VDD                | -   |              |     | +5V +/- 10%                                               |
| 2  | VDD                | -   |              |     | +5V +/- 10%                                               |
| 3  | I2S_STEREO_OUT     | I/O | GPIO13       | 28  | I2S stereo out or GPIO                                    |
| 4  | I2S_MONO_OUT       | I/O | GPIO15       | 26  | I2S mono out or GPIO                                      |
| 5  | GPIO / PWM         | I/O | GPIO19       | 25  | Function defined by firmware application.                 |
| 6  | Reset              | I   |              | 24  | Driven from open drain external source. Can be left open. |
| 7  | I2C_SCL_S / S_MISO | I/O | GPIO5        | 44  | I2C slave or SPI slave port                               |
| 8  | I2C_SDA_S / S_MOSI | I/O | GPIO4        | 45  | I2C slave or SPI slave port                               |
| 9  | I2C_SCL_M          | O   | GPIO19       | 37  | I2C master port or GPIO                                   |
| 10 | I2C_SDA_M          | I/O | GPIO18       | 43  | I2C master port or GPIO                                   |
| 11 | S_SCLK             | I   | GPIO3        | 46  | SPI slave port or GPIO                                    |
| 12 | GND                | -   |              |     | Ground                                                    |
| 13 | BCLK               | I/O | GPIO1        | 30  | Function defined by firmware application.                 |
| 14 | WCLK               | I/O | GPIO12       | 29  | Function defined by firmware application.                 |
| 15 | S_SSB              | I   | GPIO2        | 47  | SPI slave port or GPIO                                    |
| 16 | MCLK               | O   | GPIO10       | 31  | I2S port or GPIO                                          |
| 17 | I2S_STEREO_IN      | I   | GPIO14       | 27  | I2S port or GPIO                                          |
| 18 | M_SSB/GPIO6        | O   | GPIO6        | 36  | Function defined by firmware application.                 |
| 19 | M_SCLK/GPIO1       | O   | GPIO7        | 35  | Function defined by firmware application.                 |
| 20 | M_MOSI/GPIO8       | O   | GPIO8        | 34  | Function defined by firmware application.                 |
| 21 | M_MISO/GPIO9       | I   | GPIO9        | 33  | Function defined by firmware application.                 |
| 22 | DP                 | I/O | USB positive | 41  | USB 2.0 positive transceiver I/O                          |
| 23 | DM                 | I/O | USB negative | 42  | USB 2.0 negative transceiver I/O                          |
| 24 | GND                | -   |              |     | Ground                                                    |

### 3. Electrical Specifications

#### 3.1. Absolute Maximum Ratings

Absolute Maximum Ratings (AMR) are stress ratings only. AMR corresponds to the maximum value that can be applied without leading to instantaneous or very short-term unrecoverable hard failure (destructive breakdown). Stresses beyond those listed under AMR may cause permanent damage to the device.

Functional operation of the device at these or any other conditions beyond those indicated under “Recommended Operating Range” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may adversely affect device reliability.

Device functional operating limits and guaranteed performance specifications are given under Electrical Characteristics at the test conditions specified.

**Table 1-2 Absolute Maximum Ratings**

| CONDITION                             | MIN   | MAX   |
|---------------------------------------|-------|-------|
| +5V Supply Voltage Input              | -0.3V | 6.0V  |
| Input Voltage Range – Digital Inputs  | -0.3V | 3.6V  |
| Operating Temperature                 | -10°C | +70°C |
| Storage Temperature                   | -20°C | +80°C |
| Static Discharge Voltage <sup>1</sup> | -6kV  | +6kV  |

Note 1: ±6kV @ bottom test pads, 150pF/330ohms discharge per IEC/EN61000-4-2

#### 3.2. Recommended Operating Range

**Table 1-3 Recommended Operating Ranges**

| PARAMETER                             | MIN | TYP | MAX | UNIT |
|---------------------------------------|-----|-----|-----|------|
| +5V Supply pin voltage                | 4.5 | 5.0 | 5.5 | V    |
| Ambient Temperature (T <sub>A</sub> ) | 0   |     | 60  | °C   |

### 3.3. Electrical Characteristics

Test Conditions:  $T_A = +25^{\circ}\text{C}$ ,  $V_{\text{supply}} = +5.0\text{V}$

**Table 1-4; SWA13-TX RF Transceiver Characteristics**

| PARAMETER                    | CONDITIONS | MIN  | TYP | MAX  | UNIT |
|------------------------------|------------|------|-----|------|------|
| RF Frequency Range           |            | 2405 |     | 2477 | MHz  |
| Tx Output Power <sup>1</sup> |            |      | 1.5 |      | dBm  |
| Rx Sensitivity <sup>2</sup>  |            |      | -88 |      | dBm  |
| Range (LOS)                  |            |      | 15  |      | m    |

Note 1: Measured with the SWA13 PCB antenna disabled and test RF connector added.

Note 2: Measured with the SWA13 PCB antenna disabled and test RF connector added. Sensitivity is defined as the onset of 0.2% BLER Clock Error Rate.

**Table 1-5; SWA13-TX Audio Characteristics**

| PARAMETER                       | CONDITIONS            | MIN | TYP       | MAX | UNIT |
|---------------------------------|-----------------------|-----|-----------|-----|------|
| Frequency Response <sup>1</sup> |                       | 20  |           | 20K | Hz   |
| Gain Flatness <sup>2</sup>      | 0dB Input/Output Gain |     | $\pm 0.2$ |     | dB   |
| SNR                             | I2S Input/Output      |     | 94        |     | dB   |
| THD+N                           |                       |     | 94        |     | dB   |

Note 1: 16 bit audio, 44.4KSps over-the-air sample rate firmware build

Note 2: 16 bit audio, 44.4KSps over-the-air sample rate firmware build – 20 kHz frequency response

**Table 1-6; SWA13-TX Audio Latency Characteristics**

| PARAMETER                   | CONDITIONS           | MIN | TYP  | MAX | UNIT |
|-----------------------------|----------------------|-----|------|-----|------|
| 22.2KSps OTA Sample Latency | Standard Firmware    |     | 17   |     | ms   |
| 44.4KSps OTA Sample Latency | Standard Firmware    |     | 14   |     | ms   |
| 22.2KSps OTA Sample Latency | Low Latency Firmware |     | 13.5 |     | ms   |
| 44.4KSps OTA Sample Latency | Low Latency Firmware |     | 8.5  |     | ms   |

**Table 1-7; SWA13-TX Current Characteristics**

| PARAMETER               | CONDITIONS             | MIN | TYP | MAX | UNIT |
|-------------------------|------------------------|-----|-----|-----|------|
| Tx Module Configuration | Linked <sup>1</sup>    |     | 35  |     | mA   |
| Tx Module Configuration | Searching <sup>2</sup> |     | 22  |     | mA   |
| Tx Module Configuration | FCC Tx <sup>3</sup>    |     | 63  |     | mA   |

Note 1: Specification represents an average current with the I2S clocks running. Peak current is  $\sim 2\times$  the average.

Note 2: Searching is the average current where the TX module is not linked but is attempting to find a Rx module to link with. Peak current is  $\sim 70\text{mA}$ .

## Ordering Information

Table 1-8: SWA13-TX Module Ordering Information

| Module Part Number | Option Code | Description                                                    |
|--------------------|-------------|----------------------------------------------------------------|
| SWA13              | -TX         | Digital Input , FPC Connector, integrated printed PCB antennas |

**FCC Statement:****Federal Communication Commission Interference Statement**

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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This device and its antenna(s) must not be co-located or operation in conjunction with any other antenna or transmitter.

**IMPORTANT NOTE:****FCC Radiation Exposure Statement:**

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.



**IMPORTANT NOTE:**

This module is intended for OEM integrator. The OEM integrator is still responsible for the FCC compliance requirement of the end product, which integrates this module.

20cm minimum distance has to be able to be maintained between the antenna and the users for the host this module is integrated into. Under such configuration, the FCC radiation exposure limits set forth for an population/uncontrolled environment can be satisfied.

Any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

**USERS MANUAL OF THE END PRODUCT:**

In the users manual of the end product, the end user has to be informed to keep at least 20cm separation with the antenna while this end product is installed and operated. The end user has to be informed that the FCC radio-frequency exposure guidelines for an uncontrolled environment can be satisfied. The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment. If the size of the end product is smaller than 8x10cm, then additional FCC part 15.19 statement is required to be available in the users manual: This device complies with Part 15 of FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

**LABEL OF THE END PRODUCT:**

The final end product must be labeled in a visible area with the following " **Contains TX FCC ID: NKR-SWA13** ". If the size of the end product is larger than 8x10cm, then the following FCC part 15.19 statement has to also be available on the label: This device complies with Part 15 of FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

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**IC Statement:**

**This Class B digital apparatus complies with Canadian ICES-003.**

Cet appareil numérique de la classe B conforme à la norme NMB-003 du Canada.

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

*Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.*

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This device and its antenna(s) must not be co-located or operation in conjunction with any other antenna or transmitter.

**IMPORTANT NOTE:****IC Radiation Exposure Statement:**

This equipment complies with IC RSS-102 radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

**IMPORTANT NOTE:**

This module is intended for OEM integrator. The OEM integrator is still responsible for the IC compliance requirement of the end product, which integrates this module.

20cm minimum distance has to be able to be maintained between the antenna and the users for the host this module is integrated into. Under such configuration, the IC RSS-102 radiation exposure limits set forth for an population/uncontrolled environment can be satisfied.

Any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

**USERS MANUAL OF THE END PRODUCT:**

In the users manual of the end product, the end user has to be informed to keep at least 20cm separation with the antenna while this end product is installed and operated. The end user has to be informed that the IC radio-frequency exposure guidelines for an uncontrolled environment can be satisfied. The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment. IC statement is required to be available in the users manual: This Class B digital apparatus complies with Canadian ICES-003. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

**LABEL OF THE END PRODUCT:**

The final end product must be labeled in a visible area with the following " **Contains TX IC : 4441A-SWA13** ".