MikroElektronika
DEVELOPMENT TOOLS | COMPILERS | BOOKS

AUDIO AMP 5 CLICK

PID: MIKROE-3401 Weight: 29 g

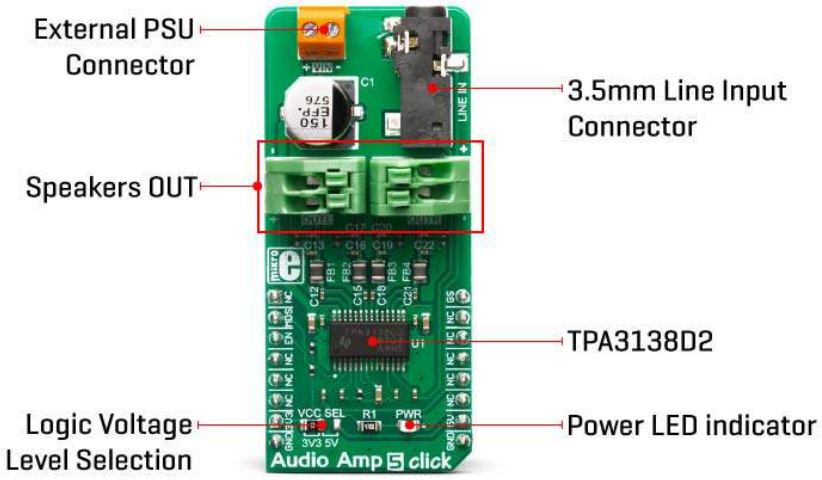
Audio Amp 5 Click is a stereo audio amplifier, capable of delivering up to 10W per channel with the 8Ω load. It is based on the TPA3138D2, a class-D integrated amplifier, which utilizes a highly efficient switching scheme. With about 20mA in idle mode, it allows for longer operation and improved thermal performance, making it a perfect choice for various battery-powered applications. Advanced EMI Suppression with Spread Spectrum Control allows using ferrite bead filters instead of bulky inductors, still maintaining the required EMC levels. The TPA3138D2 IC is equipped with a set of protection features, allowing a reliable operation.

Audio Amp 5 Click is supported by a mikroSDK compliant library, which includes functions that simplify software development. This Click board™ comes as a fully tested product, ready to be used on a system equipped with the mikroBUS™ socket.

This Click board™ requires an external Power Supply Unit (PSU) for its operation. It can use a wide range of power supply voltages, from 3.5V up to 14.4V. Audio Amp 5 click a perfect solution for different kinds of active desktop speakers, battery-powered Bluetooth® and wireless speakers, TV sets and PC monitors, and other types of consumer audio equipment. Due to its high efficiency, it can even be used as a sound reinforcement solution for various IoT applications.

HOW DOES IT WORK?

The main component of Audio Amp 5 click is the TPA3138D2, an inductorless stereo class-D audio amplifier, from Texas Instruments. It has many features which make this IC a very attractive solution for battery-powered and stand-alone active speakers. It is very flexible regarding the PSU voltage: it can work with voltages within the range from 3.5V to 14.4V. With only 3.5V at the PSU connector, it can still deliver 1W of power to 6Ω load (per channel). However, its nominal operating voltage is 12V, reaching up to 10W of power to the connected 6Ω speaker, with only 1% of Total Harmonic Distortion (THD).



The TPA3138D2 IC features a set of protections, including output short circuit, over-temperature, under-voltage, and over-voltage protection. If any of these protections are activated, they will be reported at the SD/FAULT (EN) I/O pin. The TPA3138D2 IC can also detect a constant DC current at the output. When a DC detection event occurs, the outputs are turned OFF, protecting the connected speakers that way. Very often, a DC detection event can be triggered when the circuit is powered up, so it is advisable to hold the EN pin to a LOW logic level for a short period, preventing faulty DC detection reports, as well as loud pops.

The output stage of the TPA3138D2 operates in Bridge-Tied Load (BTL) topology. This means that there are two outputs per channel: one inverted and one non-inverted

(OUTN and OUTP). Class-D amplifier produces the sound by modulating the pulse-with of the output voltage. It offers a choice of two PWM modulation schemes, selectable by the MODE_SEL pin of the IC. This pin is routed to the mikroBUS™ RST pin, labeled as MDS on this Click board™. By default, MDS pin is pulled to a LOW logic level by a resistor.

When the MDS pin is set to a LOW logic level, the TPA3138D2 uses the BD Modulation scheme. This scheme reduces the need for a typical LC reconstruction filter at the output. While there is no input, both OUTN and OUTP are in phase, with 50% duty cycle. There is no current through the speaker, in this case. The duty cycle will increase at the OUTP and decrease at the OUTN at the same time, when the positive half-phase of the audio signal is applied at the input. For the negative half-phase at the input, the opposite will happen. The greater the difference in pulse width, the greater the current through the connected speaker.

When MDS pin is set to a HIGH logic level, the TPA3138D2 uses the 1SPW Modulation scheme. This scheme allows very low idle current and better overall efficiency, at the expense of somewhat increased THD. Both OUTP and OUTN are held in phase at about 15% duty cycle. As the input signal is applied, one output is driven to the GND, while the other output increases. The modulation takes place through this single output, reducing the switching losses. Again, the positive half-phase will cause the OUTN to be driven to GND, while the negative half-phase of the input signal causes the OUTP to be driven to GND.

The SD/FAULT pin allows the host MCU to enable/disable outputs. By pulling this pin to a LOW logic level, the outputs are muted and the TPA3138D2 IC enters the low-current state, reducing the supply current to the absolute minimum level. Muting the TPA3138D2 before cutting down the power supply reduces pops and clicks that might appear in this case. The SD/FAULT pin is routed to the mikroBUS™ CS pin labeled as EN on this Click board™, and it is pulled to a HIGH logic level by a resistor.

There is a selectable input gain on Audio Amp 5 click. By applying a LOW logic level to the GAIN_SEL pin, the input gain is set to 20dB. A HIGH logic level sets the input gain to 26dB. This allows matching the input signal so that the optimal output level can be reached. This pin is routed to the mikroBUS™ PWM pin labeled as GS, and it is pulled to the LOW logic level by a resistor.

The external PSU should be connected to the VIN terminal. A line-level audio source can be connected to the LINE IN 3.5mm jack stereo connector, while the speakers should be connected to the angled spring-terminals, labeled as OUTL and OUTR. These terminals have their polarities marked on the top overlay.

Although the TPA3138D2 IC requires an external PSU, it still uses power from the mikroBUS™ for the logic levels of its control pins. There is a logic voltage level selection SMD jumper labeled as VCC SEL, which allows interfacing with both 3.3V and 5V-tolerant pins of the host MCU.

SPECIFICATIONS

Type	Amplifier
Applications	A perfect solution for different kinds of active desktop speakers, battery-powered BT and wireless speakers, TV sets and PC monitors, and other types of consumer audio equipment. Due to its high efficiency, it can even be used as a sound reinforcement solution for various IoT applications.
On-board modules	TPA3138D2, an inductorless stereo class-D audio amplifier, from Texas Instruments.
Key Features	High efficiency, low power dissipation with no extra heat-sinks required, a set of protection features for reliable operation, it can be operated with the wide range of voltages, etc.
Interface	GPIO
Input Voltage	3.3V or 5V
Click board size	L (57.15 x 25.4 mm)

PINOUT DIAGRAM

This table shows how the pinout on **AudioAmp 5 Click** corresponds to the pinout on the mikroBUS™ socket (the latter shown in the two middle columns).

Notes	Pin					Pin	Notes
	NC	1	AN	PWM	16	**GS**	Gain Select
Mode Selection	**MDS**	2	RST	INT	15	NC	

Chip Enable/Fault	**EN**	3	CS	RX	14	NC	
	NC	4	SCK	TX	13	NC	
	NC	5	MISO	SCL	12	NC	
	NC	6	MOSI	SDA	11	NC	
Power Supply	**3V3**	7	3.3V	5V	10	**5V**	Power Supply
Ground	**GND**	8	GND	GND	9	**GND**	Ground

ONBOARD SETTINGS AND INDICATORS

Label	Name	Default	Description
PWR	PWR	-	Power LED indicator
JP1	VCC SEL	Left	Logic voltage level selection: left position 3.3V, right position 5V
CN1	LINE IN	-	3.5mm stereo jack for audio input
OUTL	OUTL	-	Left speaker connector
OUTR	OUTR	-	Right speaker connector
VIN	VIN	-	External PSU connector

2X30W AMP ELECTRICAL CHARACTERISTICS

Description	Min	Typ	Max	Unit
External PSU Voltage	3.5		14.4	V
Minimum load Impedance	3.2			Ω
Continuous output power		10		W
Total Harmonic Distortion (THD) at 10W; 6Ω; 10V		1		%
Signal-to-Noise Ratio (SNR)		102		dB

SOFTWARE SUPPORT

We provide a library for the **AudioAmp 5 Click** on our LibStock page, as well as a demo application (example), developed using MikroElektronika compilers. The demo can run on all the main MikroElektronika development boards.

Library Description

The library performs the audio control of the Audio Amp 5 Click board. This library consists of the special commands for audio output control, for example to mute/turn on the outputs, to select the desired output gain or mode. For more details check documentation.

Key functions:

- `void audioamp5_enable( uint8_t state )` - Function performs a shutdown or power up action, and on that way selects outputs to be muted or activated.
- `void audioamp5_modeSelect( uint8_t state )` - Function puts a device to the desired mode.
- `void audioamp5_gainSelect( uint8_t state )` - Function performs a desired gain selection.

Examples description

The application is composed of the three sections :

- System Initialization - Initializes peripherals and pins.
- Application Initialization - Initializes GPIO interface on the desired mikrobus selection and performs a device init configuration.

- Application Task - (code snippet) - Checks the entered command and, if the command is valid, performs a device configuration which the entered command determines. Note : After each command for device configuration, the command for configuration updating will be executed. When BD Mode (0) is selected, the VIN supply voltage threshold is 7.5V. When Low-Idle-Current 1SPW Mode is selected, the VIN supply voltage threshold is 3.4V.

```
void applicationTask()
{
    rxDat = UART_Rdy_Ptr();

    if (rxDat != UART_RX_NOT_READY)
    {
        rxDat = UART_Rd_Ptr();

        switch (rxDat)
        {
            case 'm' :
            {
                audioamp5_enable( _AUDIOAMP5_SHDWN_MUTE_OUTPUTS );
                mikrobus_logWrite( "** Outputs are muted **", _LOG_LINE );
            break;
            }
            case 'e' :
            {
                audioamp5_enable( _AUDIOAMP5_PWRUP_UNMUTE_OUTPUTS );
                mikrobus_logWrite( "** Outputs are enabled **", _LOG_LINE );
            break;
            }
            case '0' :
            {
                audioamp5_modeSelect( _AUDIOAMP5_BD_MODE );
                audioamp5_configUpdate();
                mikrobus_logWrite( "** BD Mode is selected **", _LOG_LINE );
            break;
            }
            case '1' :
            {
                audioamp5_modeSelect( _AUDIOAMP5_1SPW_MODE );
```

```
                audioamp5_configUpdate();
                mikrobus_logWrite( "** Low-Idle-Current 1SPW Mode is selected **", _LOG_LINE )
;
            break;
            }
            case '-' :
            {
                audioamp5_gainSelect( _AUDIOAMP5_GAIN_20DB );
                audioamp5_configUpdate();
                mikrobus_logWrite( "** Gain value is 20dB **", _LOG_LINE );
            break;
            }
            case '+' :
            {
                audioamp5_gainSelect( _AUDIOAMP5_GAIN_26DB );
                audioamp5_configUpdate();
                mikrobus_logWrite( "** Gain value is 26dB **", _LOG_LINE );
            break;
            }
            default :
            {
                writeLegend();
            break;
            }
        }
    }
}
```

Additional Functions :

All additional functions such as timer initialization and default handler.

The full application code, and ready to use projects can be found on our LibStock page.
Other mikroE Libraries used in the example:

- UART

Additional notes and informations

Depending on the development board you are using, you may need USB UART click, USB UART 2 click or RS232 click to connect to your PC, for development systems with no UART to USB interface available on the board. The terminal available in all MikroElektronika compilers, or any other terminal application of your choice, can be used to read the message.

MIKROSDK

This click board is supported with mikroSDK - MikroElektronika Software Development Kit. To ensure proper operation of mikroSDK compliant click board demo applications, mikroSDK should be downloaded from the LibStock and installed for the compiler you are using.

For more information about mikroSDK, visit the official page.