

# IS31AP2036 HIGH EFFICIENCY, CLASS-K AUDIO POWER AMPLIFIER WITH INTEGRATED CHARGE PUMP CONVERTER

## DESCRIPTION

The IS31AP2036 is a Class-K audio power amplifier with high efficiency and automatic gain control. It drives up to 2.0W (10% THD+N) into an 8Ω speaker from a 4.2V VCC supply.

The IS31AP2036 integrates advanced high efficiency charge pump and whole power amplifier efficiency can be up to 75%. The output power will be maintained in 0.8W, 1.0W and 1.2W.

The IS31AP2036 provides low cost, space saving solution for portable equipments which need audio output with higher power by boosting up supply voltage. Its external components just include a few capacitors and resistors (no inductor).

The demo board has four modes to test the functionality of the IS31AP2036.

## FEATURES

- Operates from 3.0V to 5.0V
- Ultra low output noise floor
- Low EMI
- -65dB (217Hz) high PSRR
- 0.05% low THD+N
- Pulse Count Control serial interface
- Thermal and short-circuit protection
- Integrated Click-and-Pop suppression circuitry
- Available in FCQFN-16 (2mm × 2mm) package

## QUICK START

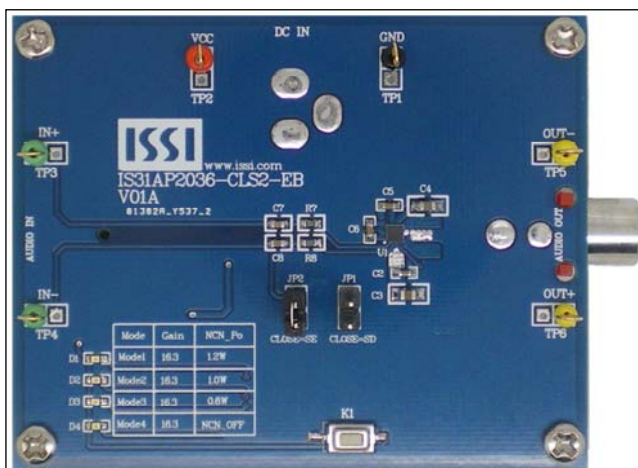


Figure 1: Photo of IS31AP2036 Evaluation Board

## RECOMMENDED EQUIPMENT

- 3.0~5.0V, 2A power supply
- Audio source (i.e. MP3 player, Notebook PC, etc.)
- 8Ω or 4Ω speakers

## ABSOLUTE MAXIMUM RATINGS

- ≤ 5.0V power supply

**Caution: Do not exceed the conditions listed above, otherwise the board will be damaged.**

## PROCEDURE

The IS31AP2036 demo board is fully assembled and tested. Follow the steps below to verify board operation.

**Caution: Do not turn on the power supply until all connections are completed.**

- 1) Connect a 4Ω (or larger) speaker across the OUT-terminal and OUT+ terminal or the RCA female connector (AUDIO OUT).
- 2) Connect the ground terminal of the power supply to the GND (TP1) and the positive terminal to the VCC (TP2). Or connect DC power to connector (DC IN) with a 2.5 mm Jack.
- 3) If the audio source is differential, remove jumper JP2, connect the negative of the audio source to the IN- terminal, and connect the positive of the audio source to IN+ terminal.
- 4) If the audio source is single-ended, connect the audio source to the IN+ terminal, and close jumper JP2; or connect audio source to the audio mono connector (AUDIO IN) and close jumper JP2.
- 5) Turn on the audio source.
- 6) Turn on the power supply

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## ORDERING INFORMATION

Part No.	Temperature Range	Package
IS31AP2036-CLS2-EB	-40°C ~ +85°C (Industrial)	FCQFN-16, Lead-free

Table 1: Ordering Information

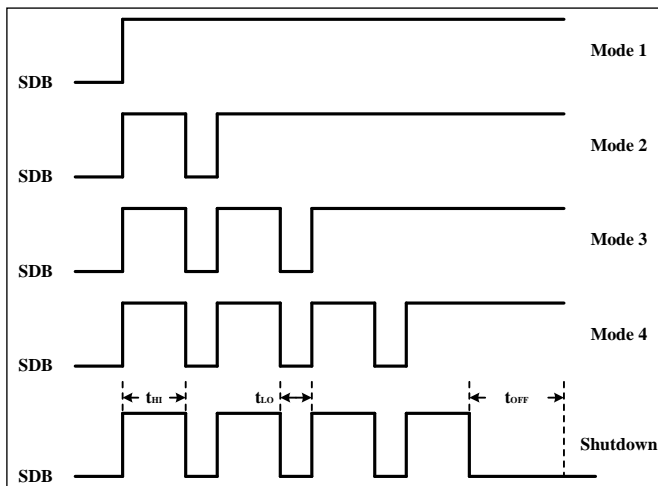
For pricing, delivery, and ordering information, please contact ISSI's analog marketing team at [analog@issi.com](mailto:analog@issi.com) or (408) 969-6600.

## EVALUATION BOARD OPERATION

The IS31AP2036 demo board has an LPC922 MCU to read the status of the button (K1) which select between the different modes. The current operating mode is indicated by the illuminated LED on the left side. The default mode is shutdown.

## MODE SETTINGS

The operating mode is controlled by Pulse Count Control (PCC wire) serial interface. The interface records rising edges of the SDB pin and decodes them into 4 operating mode as below.



SDB Status	Function
1 Pulse	Mode1(NCN power 1.2W) $R_L = 8\Omega$
2 Pulse	Mode2(NCN power 1.0W) $R_L = 8\Omega$
3 Pulse	Mode3(NCN power 0.8W) $R_L = 8\Omega$
4 Pulse	Mode4(NCN OFF)
Pull low(1ms)	Shutdown

$t_{HI}$  and  $t_{LO}$  are from 0.75µs to 10µs and 2µs is recommended.

Switch modes: it should pull down the SDB pin low over  $t_{OFF}$  (recommended 1ms) to shut down the IC and send pulse again to switch modes.

## GAIN SETTING

The IS31AP2036 demo board is shipped with a gain of 16.4V/V, and is set by resistors  $R_{IN}$  ( $R_{Internal}$  (16.5kΩ) +  $R_{External}$  ( $R_7$  or  $R_8$ )). Change resistors  $R_7$  and  $R_8$  to reconfigure the gain of the board. Gain determined in Equation (1)

$$Gain = \frac{320k\Omega}{R_{Internal} + R_{External}} \left( \frac{V}{V} \right) \quad (1)$$

## HIGH-PASS FILTER

The evaluation board's high-pass filter consists of the input capacitors  $C_{IN}$  ( $C_7$  or  $C_8$ ) and  $R_{IN}$  ( $R_{Internal}$  (16.5kΩ) +  $R_{external}$  ( $R_7$  or  $R_8$ )). The filter's corner frequency,  $f_c$ , is determined by Equation (2).

$$f_c = \frac{1}{(2\pi R_{IN} C_{IN})} \quad (2)$$

## SHUTDOWN MODE

Jumper (JP1) controls the shutdown pin of the IS31AP2036 IC. Connect the shunt across pin 1 and 2 of the jumper (JP1) to enter the shutdown mode of the board.

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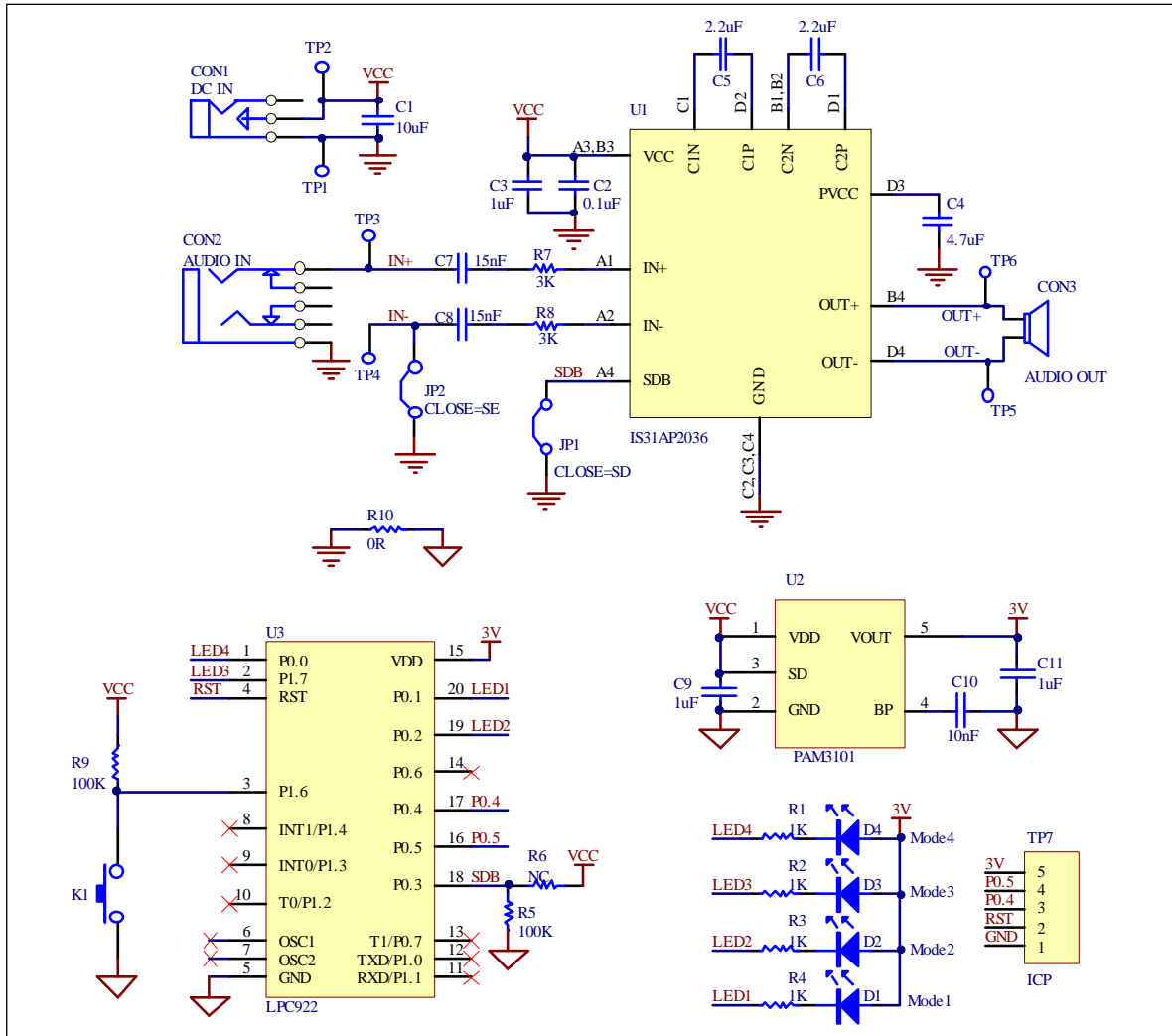


Figure 2: IS31AP2036 Application Schematic



# IS31AP2036 HIGH EFFICIENCY, CLASS-K AUDIO POWER AMPLIFIER WITH INTEGRATED CHARGE PUMP CONVERTER

## BILL OF MATERIALS

Name	Symbol	Description	Qty	Supplier	Part No.
Amplifier	U1	Class-K audio amplifier	1	ISSI	IS31AP2036-CLS2-TR
LDO	U2	Low-dropout regulator	1	PAM	PAM3101
MCU	U3	Microcontroller	1	NXP	LPC922
LED	D1~D4	LEDs Blue, SMD	4	Everlight	19-217/BHC-ZL1M2RY/3T
Resistor	R1~R4	RES,1K,1/16W,±5%,SMD	4	Yageo	RC0603JR-071KL
Resistor	R5,R9	RES,100K,1/16W,±5%,SMD	2	Yageo	RC0603JR-07100KL
Resistor	R7,R8	RES,3K,1/16W,±1%,SMD	2	Yageo	RC0603FR-073KL
Resistor	R10	RES,0R,1/16W,±5%,SMD	1	Yageo	RL0603JR-070KL
Resistor	R6	NC			
Capacitor	C1	CAP,10µF,10V,±10%,SMD	1	Yageo	CC0805KRX7R6BB106
Capacitor	C3,C9,C11	CAP,1µF,50V,±10%,SMD	3	Yageo	CC0805KRX7R9BB105
Capacitor	C2	CAP,0.1µF,50V,±10%,SMD	1	Yageo	CC0603KRX7R9BB104
Capacitor	C9,C11	CAP,0.1µF,50V,±10%,SMD	2	Yageo	CC0805KRX7R9BB104
Capacitor	C10	CAP,10nF,50V,±10%,SMD	1	Yageo	CC0603KRX7R8BB103
Button	K1	Button SMD	1		
Connector	DC IN	2.5mm DC JACK	1		
Connector	AUDIO OUT	RCA type plugs	1		
Connector	AUDIO IN	3.5mm min plug	1		
TP1~TP6	TP1~TP6	Test pins	6		

Bill of materials refers to Figure 2 above.

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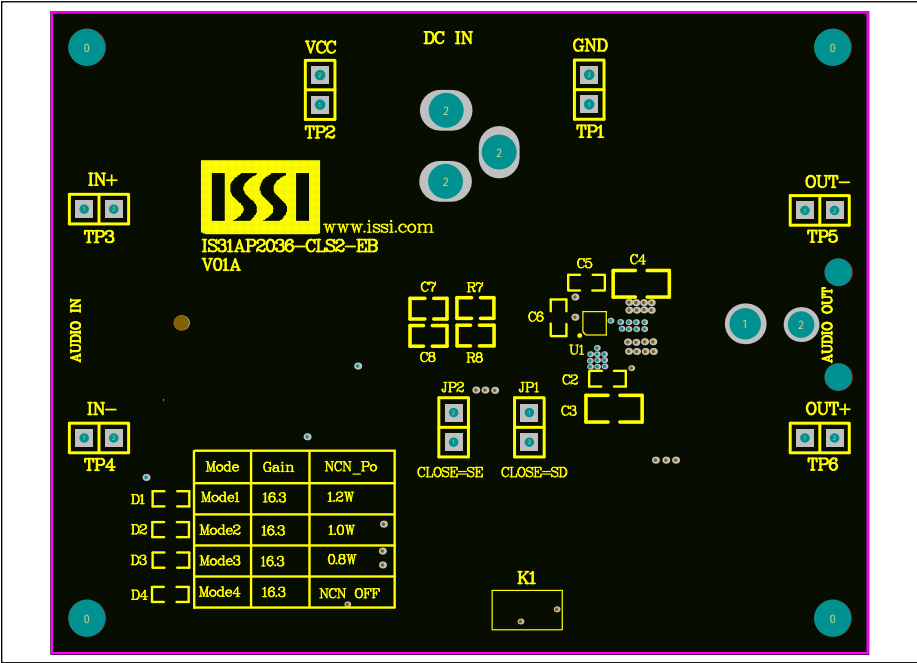


Figure 3: Board Component Placement Guide - Top Layer

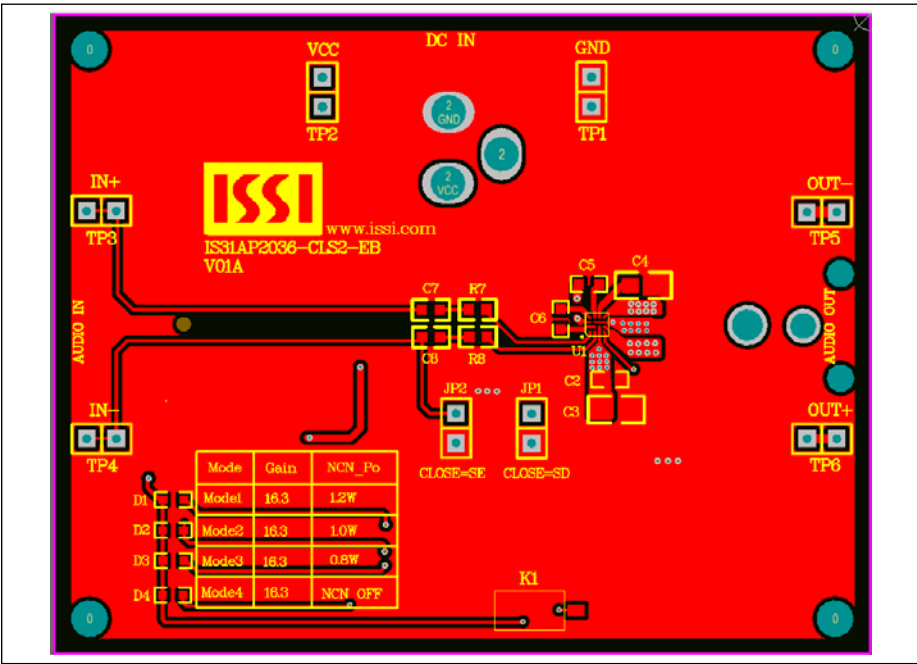


Figure 4: Board PCB Layout - Top Layer

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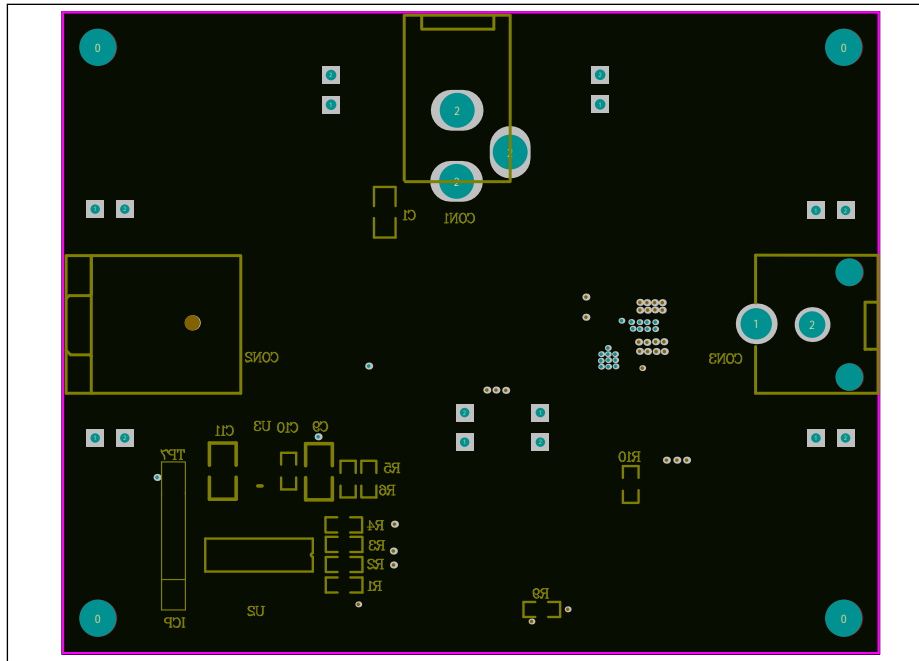


Figure 5: Board Component Placement Guide - Bottom Layer

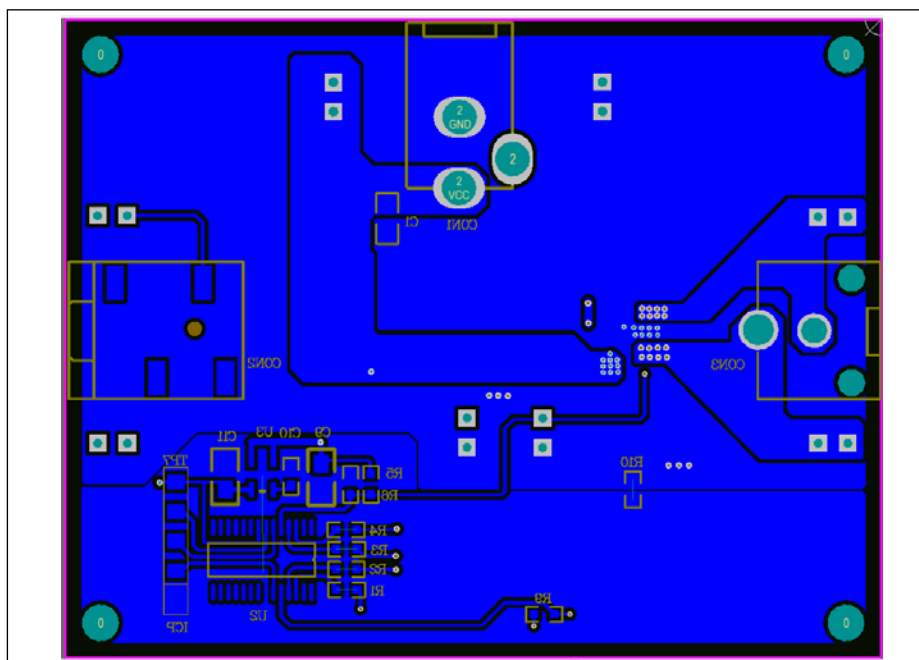


Figure 6: Board PCB Layout - Bottom Layer

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