1W Class-AB AUDIO POWER AMPLIFIER

General Description :

*The **AP4890** is an audio power amplifier primarily designed for demanding applications in mobile phones and other portable communication device applications. It is capable of delivering 1 watt of continuous average power to an 8Ω BTL load with less than 0.1% distortion (THD+N) from a 5VDC power supply.*

*The **AP4890** does not require output coupling capacitors or bootstrap capacitors, and therefore is ideally suited for mobile phone and other low voltage applications where minimal power consumption is a primary requirement.*

*The **AP4890** features a low-power consumption shutdown mode, which is achieved by driving the shutdown pin with logic low. The AA4890 is unity-gain stable and can be configured by external gain-setting resistors.*

Key Specifications :

- *PSRR at 217Hz, VDD = 5V (Fig. 1) 68dB (typ.)*
- *Power Output at 5.0V & 1% THD 1W (typ.)*
- *Power Output at 3.3V & 1% THD 400mW (typ.)*
- *Shutdown Current 0.1μA (typ.)*
- *Ultra low quiescent current < 1mA (typ)*

Features :

- *Available space-saving packages:CSP,MSOP, SO,DFN*
- *Ultra low current shutdown/quiecent mode*
- *BTL output can drive capacitive loads*
- *2.2 - 5.5V operation*
- *No output coupling capacitors, RC networks or bootstrap capacitors equired*
- *Unity-gain stable*
- *External gain configuration capability*

Applications :

- *Mobile Phones*
- *PDAs*
- *Portable electronic devices*
- *GPS*

▪ Absolute Maximum Ratings (Note 2)

If Military/Aerospace specified devices are required, please contact the APLUS Sales Office/ Distributors for availability and specification APLUS.

Supply Voltage	6.0V
Storage Temperature	−65°C to +150°C
Input Voltage	−0.3V to VDD +0.3V
Power Dissipation	Internally Limited
ESD Susceptibility	3KV
Junction Temperature	150°C
Thermal Resistance	

- Θ_{JC} (SOP) 35°C/W
- Θ_{JA} (SOP) 150°C/W
- Θ_{JC} (MSOP) 56°C/W
- Θ_{JA} (MSOP) 190°C/W

▪ Operating Ratings

Temperature Range

TMIN ≤ TA ≤ TMAX	−40°C ≤ TA ≤ 85°C
Supply Voltage	2.2V ≤ VDD ≤ 5.5V

▪ Electrical Characteristics VDD = 5V

The following specifications apply for the circuit shown in Figure 1 unless otherwise specified. Limits apply for TA = 25°C.

Symbol	Parameter	Conditions	Typical	Limit	Units (Limits)
I_{DD}	Quiescent Power Supply Current	V_{IN}=0V,IO=0A,No Load	1	2	mA(max)
		VIN=0V,IO=0A,8Ω Load	1	2	mA(max)
I_{SD}	Shutdown current	$V_{SHUTDOWN}$ = 0V	0.1	2.0	uA(max)
V_{SDIH}	Shutdown voltage input High			1.2	V(min)
V_{SDIL}	Shutdown voltage input Low			0.4	V(max)
V_{OS}	Output ofsett voltage		7	50	mV(max)
$R_{OUT-GND}$	Resister output to GND (Note 10)		8	10	KΩ(max)
				8.0	KΩ(min)
P_O	Output Power (8Ω)	THD=1%(MAX);f=1kHz	1.0	0.8	W
T_{WU}	Wake-up time		170	220	ms(min)
T_{SD}	Thermal Shutdown Temperature		170	150	℃ (min)
				190	℃ (max)
THD+N	Total Harmonic Distortion+Noise	Po=0.4Wrms;f=1kHz	0.1		%
PSRR	Power Supply Rejection Ratio	Vripple=200mV sine p-p input Terminated 10 ohms to ground	68(f=217Hz) 70(f=1kHz)	58	dB(min)
T_{SDT}	Shutdown Time	8Ω load	1.0		ms(max)

▪ Electrical Characteristics VDD = 3V

The following specifications apply for the circuit shown in Figure 1 unless otherwise specified. Limits apply for TA = 25°C.

Symbol	Parameter	Conditions	Typical	Limit	Units (Limits)
I_{DD}	Quiescent Power Supply Current	V_{IN}=0V,IO=0A,No Load	1	2	mA(max)
		VIN=0V,IO=0A,8Ω Load	4.5	2	mA(max)
I_{SD}	Shutdown current	$V_{SHUTDOWN}$ = 0V	0.1	2.0	uA(max)
V_{SDIH}	Shutdown voltage input High			1.2	V(min)
V_{SDIL}	Shutdown voltage input Low			0.4	V(max)
V_{OS}	Output ofsett voltage		7	50	mV(max)
$R_{OUT-GND}$	Resister output to GND (Note 10)		8.5	9.7	KΩ(max)
				7.0	KΩ(min)
P_O	Output Power (8Ω)	THD=1%(MAX);f=1kHz	0.31	0.28	W
T_{WU}	Wake-up time		180	180	ms(min)
T_{SD}	Thermal Shutdown Temperature		170	150	℃ (min)
				190	℃ (max)
THD+N	Total Harmonic Distortion+Noise	Po=0.15Wrms;f=1kHz	0.1		%
PSRR	Power Supply Rejection Ratio	Vripple=200mV sine p-p input Terminated 10 ohms to ground	58(f=217Hz) 64(f=1kHz)	47	dB(min)

▪ Electrical Characteristics VDD = 2.6V

The following specifications apply for the circuit shown in Figure 1 unless otherwise specified. Limits apply for TA = 25°C.

Symbol	Parameter	Conditions	Typical	Limit	Units (Limits)
I_{DD}	Quiescent Power Supply Current	V_{IN}=0V,IO=0A,No Load	2.6		mA(max)
I_{SD}	Shutdown current	$V_{SHUTDOWN}$ = 0V	0.1		uA(max)
P_O	Output Power (8Ω)	THD=1%(MAX);f=1kHz	0.2		W
	Output Power (4Ω)	THD=1%(MAX);f=1kHz	0.22		W
THD+N	Total Harmonic Distortion+Noise	Po=0.1Wrms;f=1kHz	0.08		%
PSRR	Power Supply Rejection Ratio	Vripple=200mV sine p-p input Terminated 10 ohms to ground	48(f=217Hz) 46(f=1kHz)		dB(min)

▪ External Components Description (*Figure 1*)

Components		Functional Description
1	**RIN**	*Inverting input resistance which sets the closed-loop gain in conjunction with Rf. This resistor also forms a high pass filter with CIN at fC= 1/(2RINCIN).*
2	**CIN**	*Input coupling capacitor which blocks the DC voltage at the amplifier's input terminals. Also creates a high pass filter with RIN at fc = 1/(2RINCIN). Refer to the section, Proper Selection of External Components, for an explanation of how to determine the value of CIN.*
3	**Rf**	*Feedback resistance which sets the closed-loop gain in conjunction with RIN.*
4	**Cs**	*Supply bypass capacitor which provides power supply filtering. Refer to the section, Power Supply Bypassing, for information concerning proper placement and selection of the supply bypass capacitor, CBYPASS.*
5.	**CBYPASS**	*Bypass pin capacitor which provides half-supply filtering. Refer to the section, Proper Selection of External Components, for information concerning proper placement and selection of CBYPASS.*

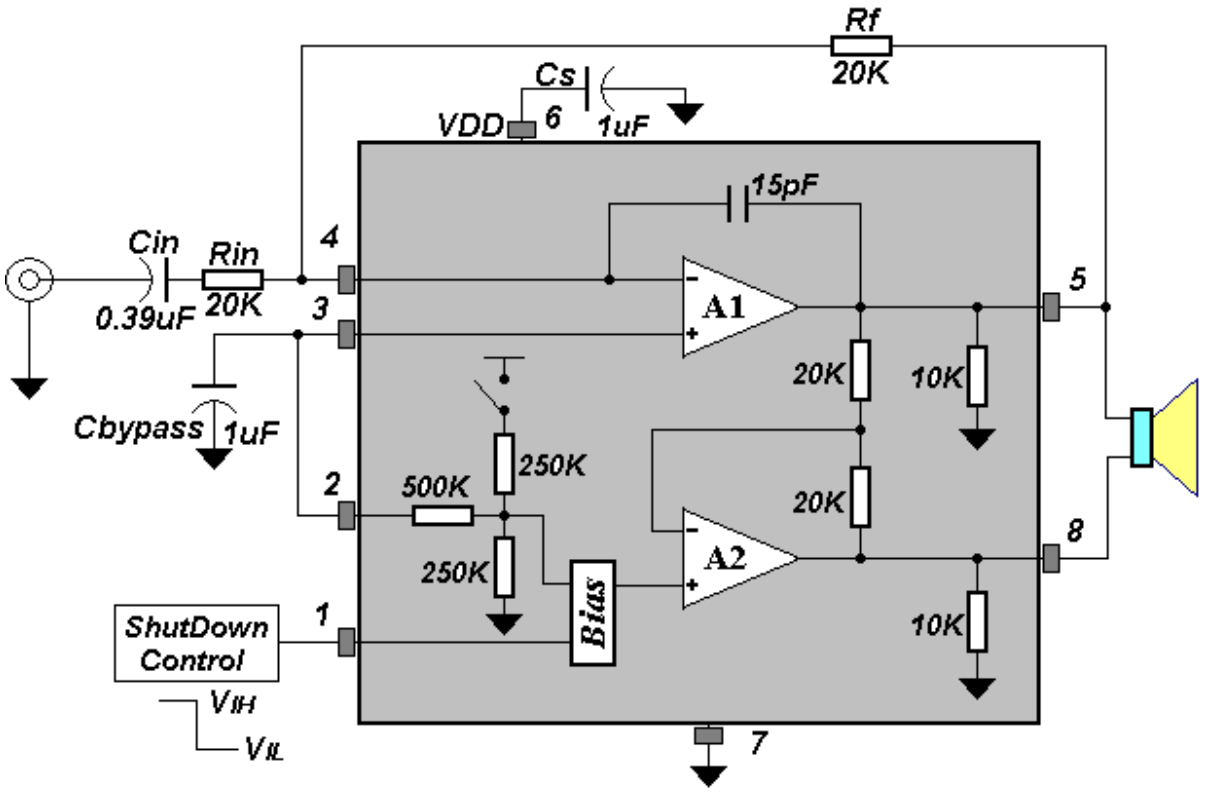


FIGURE 1. Typical Audio Amplifier Application Circuit

- *Application Information*

*As stated in the **External Components** section, RIN in con- junction with CIN create a highpass filter.*

$C_{IN} \geq 1/(2 \quad *20\ k\Omega*20Hz) = 0.397\mu F$; use 0.39μF

The high frequency pole is determined by the product of the desired frequency pole f_H, and the differential gain, A_{VD}.

With a A_{VD} = 3 and f_H = 100kHz, the resulting GBWP = 300kHz which is much smaller than the AP4890 GBWP of 2.5MHz. This calculation shows that if a designer has a need to design an amplifier with a higher differential gain, the AP4890 can still be used without running into bandwidth limitations.

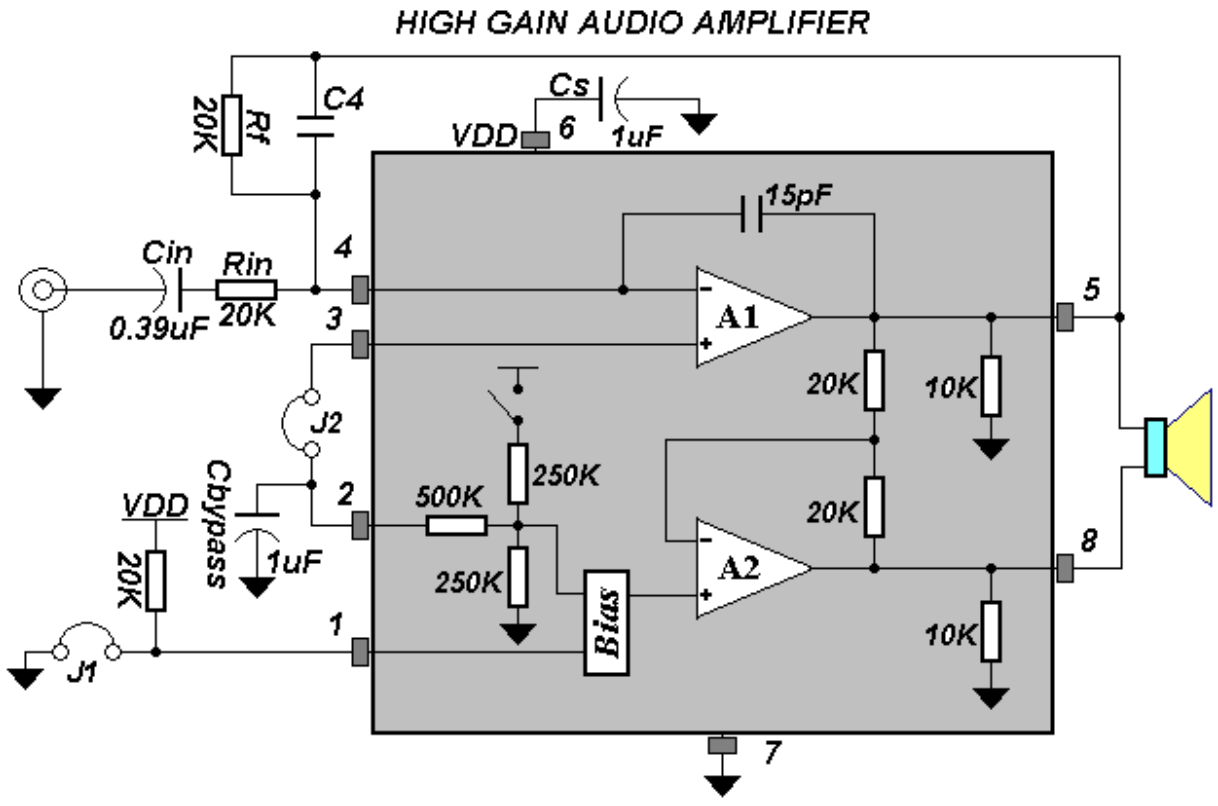


FIGURE 2.

The AP4890 is unity-gain stable and requires no external components besides gain-setting resistors, an input coupling capacitor, and proper supply bypassing in the typical application. However, if a closed-loop differential gain of greater than 10 is required, a feedback capacitor (C4) may be needed as shown in ***Figure 2*** *to bandwidth limit the amplifier. This feedback capacitor creates a low pass filter that eliminates possible high frequency oscillations.*

Care should be taken when calculating the -3dB frequency in that an incorrect combination of R3 and C4 will cause rolloff before 20kHz. A typical combination of feedback resistor and capacitor that will not produce audio band high frequency rolloff is R3 = 20kΩ and C4 = 25pf. These components result in a -3dB point of approximately 320 kHz.

- ***Application Information*** *(Continued)*

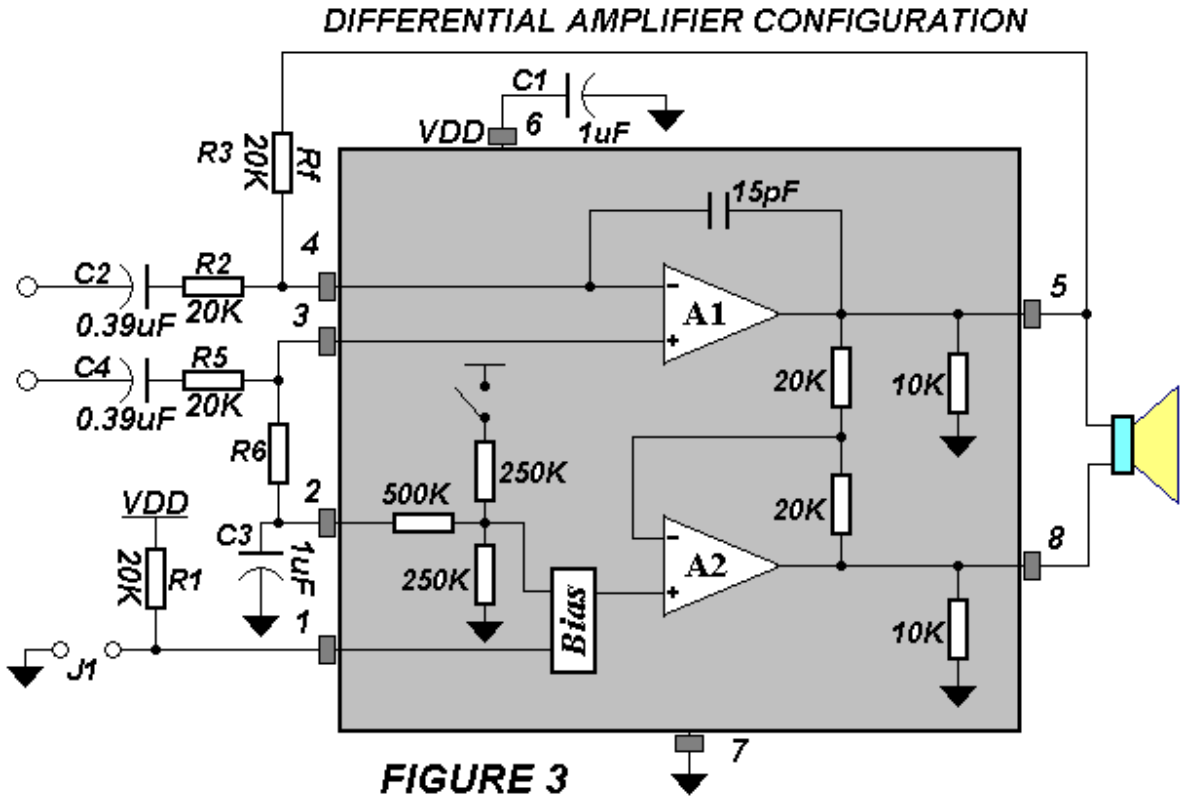
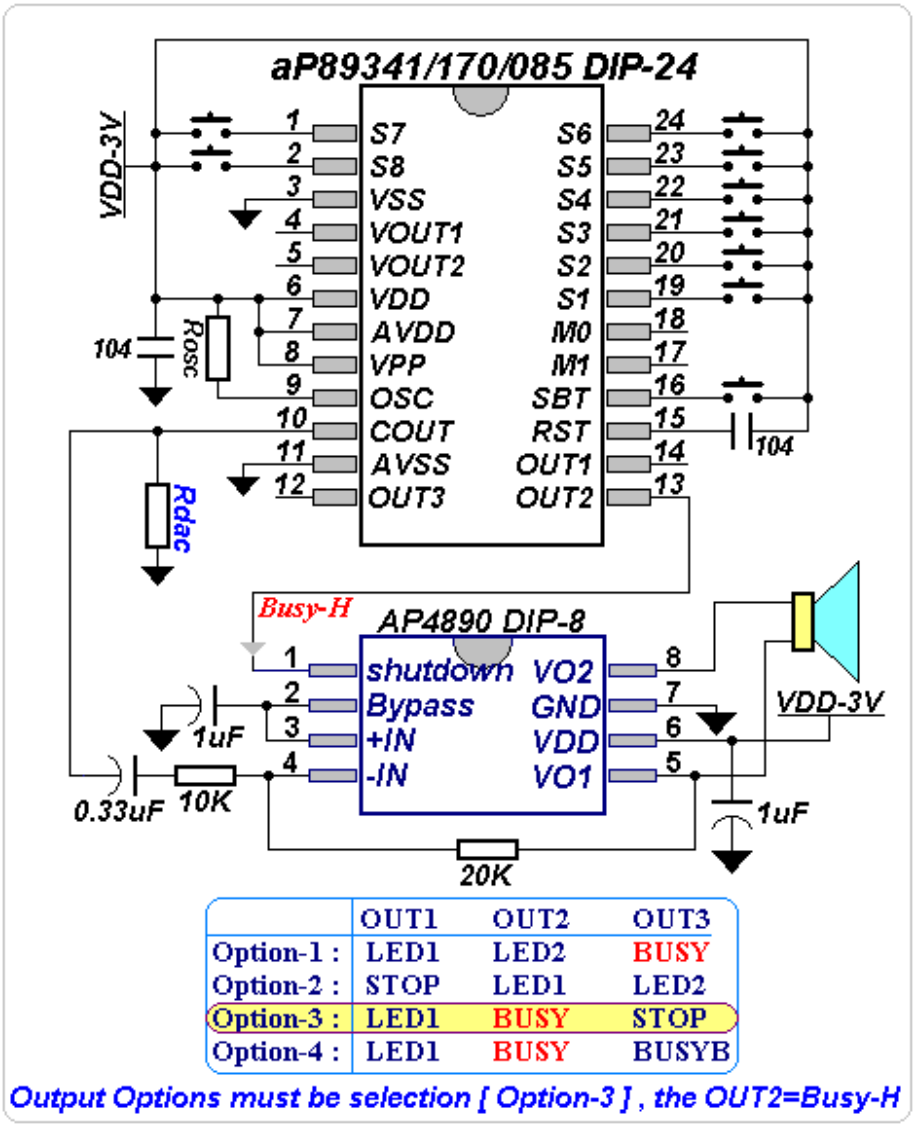


FIGURE 3

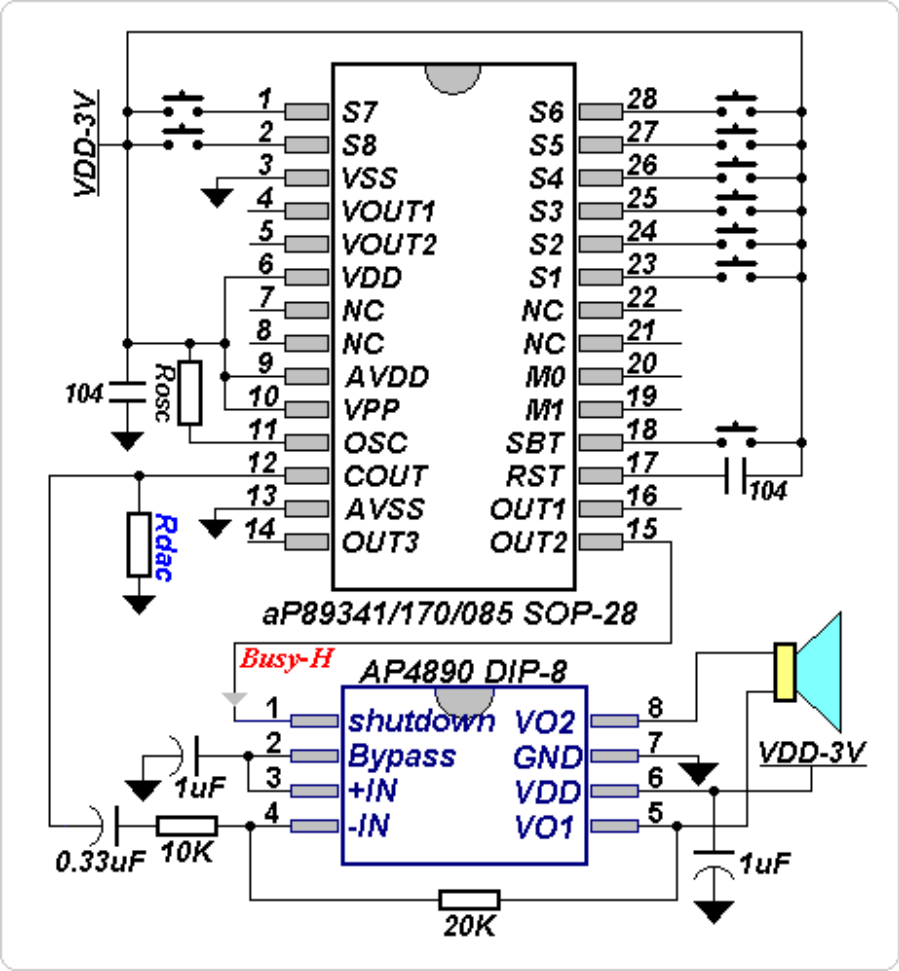
- ***Application for VOICE OTP --- aP89xx series IC :***

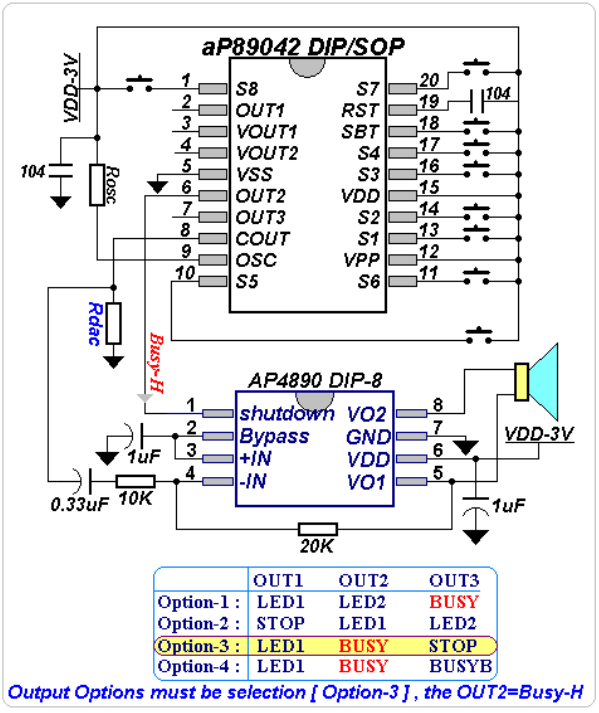


	OUT1	OUT2	OUT3
Option-1 :	LED1	LED2	BUSY
Option-2 :	STOP	LED1	LED2
Option-3 :	LED1	BUSY	STOP
Option-4 :	LED1	BUSY	BUSYB

Output Options must be selection [Option-3] , the OUT2=Busy-H

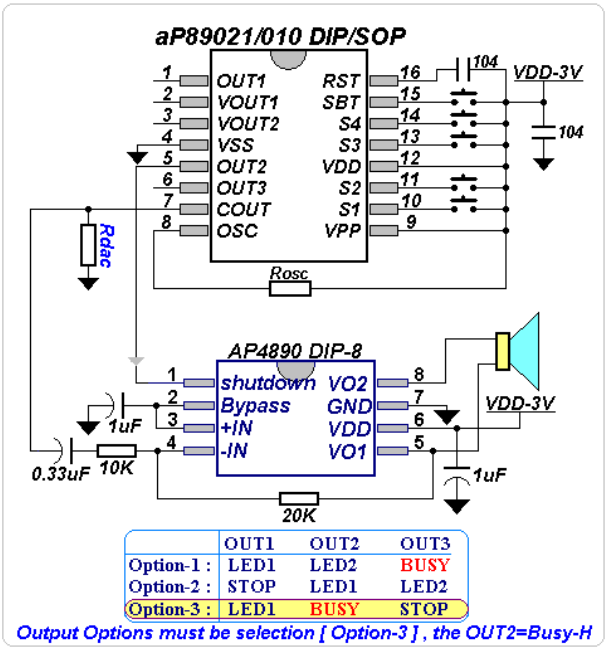
PS : the Rdac about 680 ~ 1K Ohm





	OUT1	OUT2	OUT3
Option-1 :	LED1	LED2	BUSY
Option-2 :	STOP	LED1	LED2
Option-3 :	LED1	BUSY	STOP
Option-4 :	LED1	BUSY	BUSYB

Output Options must be selection [Option-3] , the OUT2=Busy-H

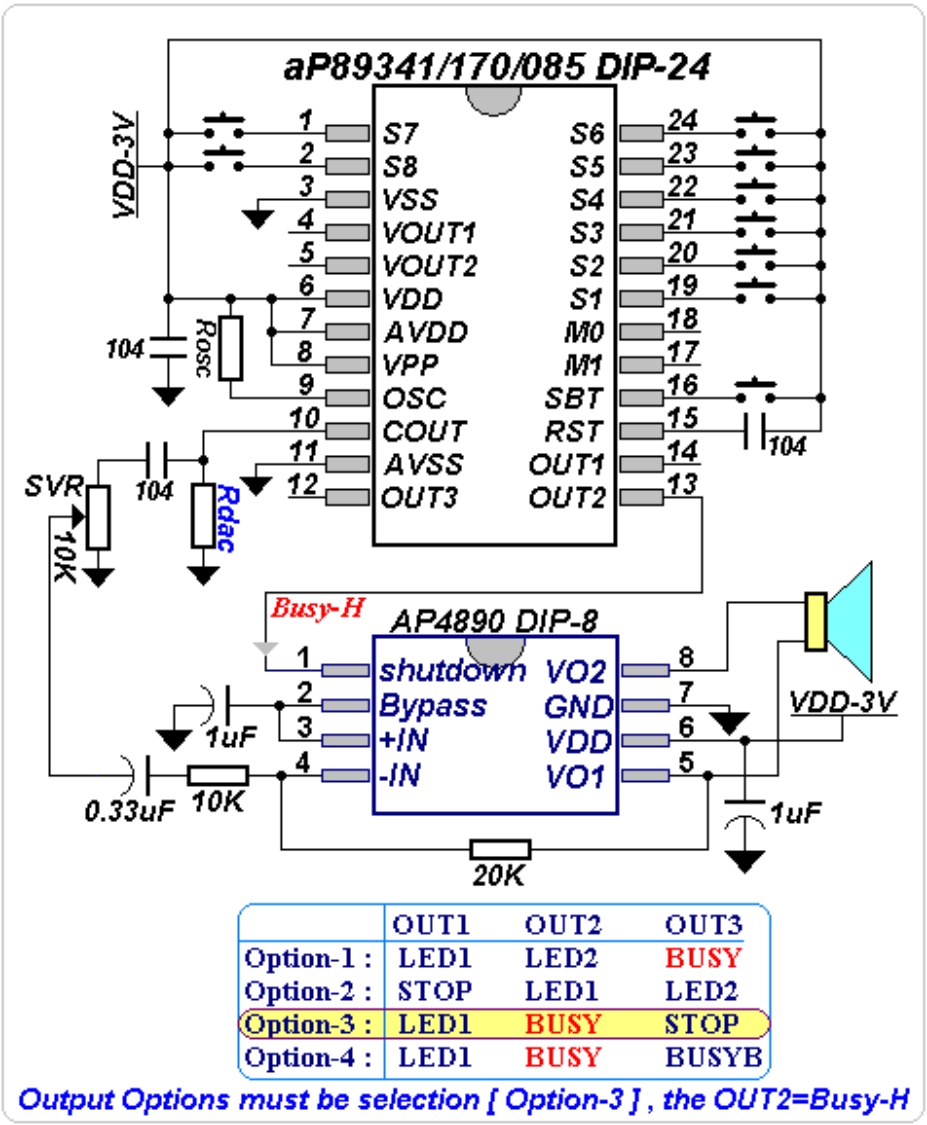


	OUT1	OUT2	OUT3
Option-1 :	LED1	LED2	BUSY
Option-2 :	STOP	LED1	LED2
Option-3 :	LED1	BUSY	STOP

Output Options must be selection [Option-3] , the OUT2=Busy-H

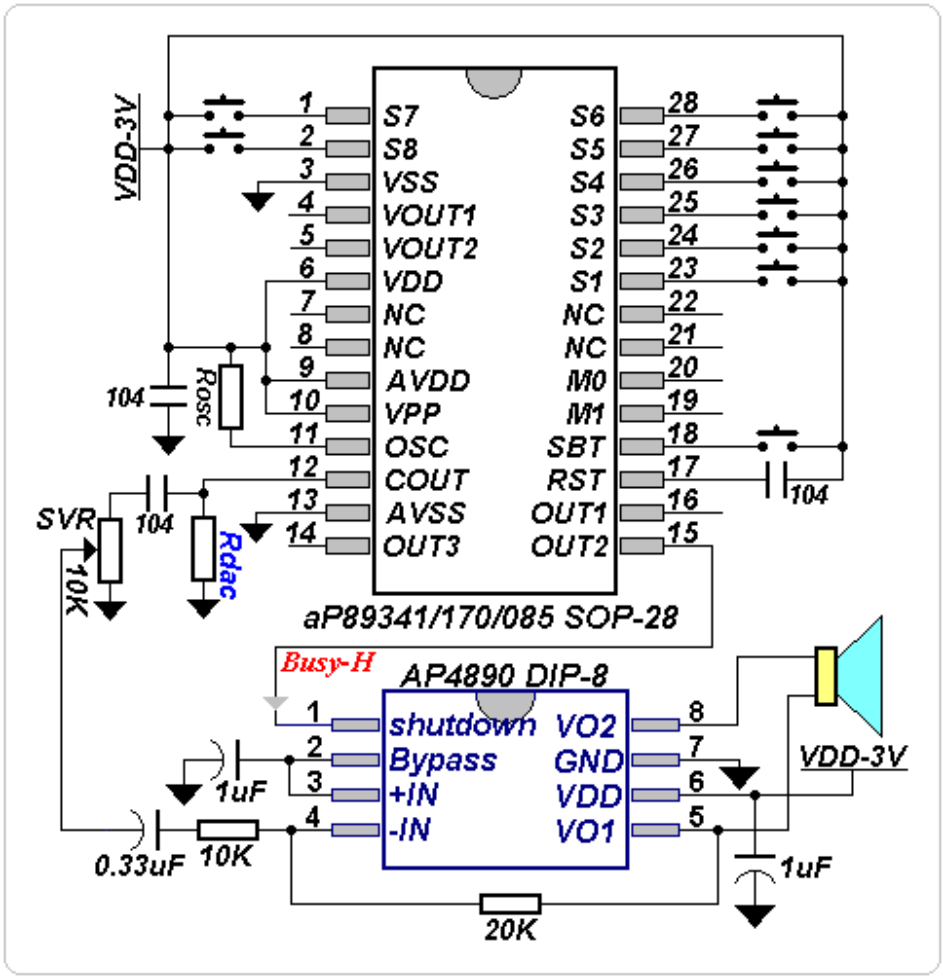
- ***Application for VOICE OTP ---***

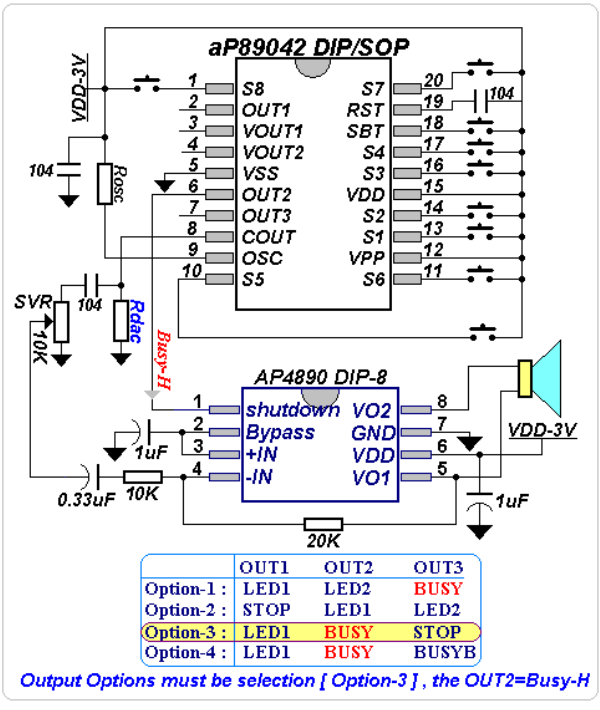
aP89xx series IC & SVR volume adjust :



	OUT1	OUT2	OUT3
Option-1 :	LED1	LED2	BUSY
Option-2 :	STOP	LED1	LED2
Option-3 :	LED1	BUSY	STOP
Option-4 :	LED1	BUSY	BUSYB

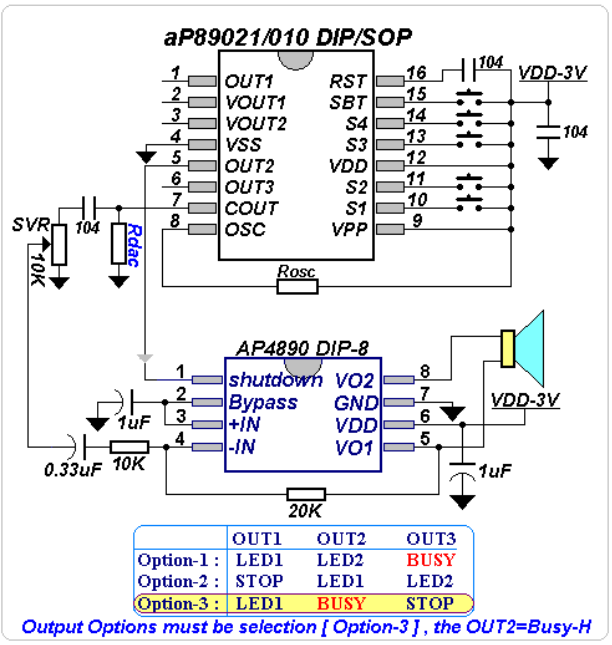
Output Options must be selection [Option-3] , the OUT2=Busy-H





	OUT1	OUT2	OUT3
Option-1 :	LED1	LED2	BUSY
Option-2 :	STOP	LED1	LED2
Option-3 :	LED1	BUSY	STOP
Option-4 :	LED1	BUSY	BUSYB

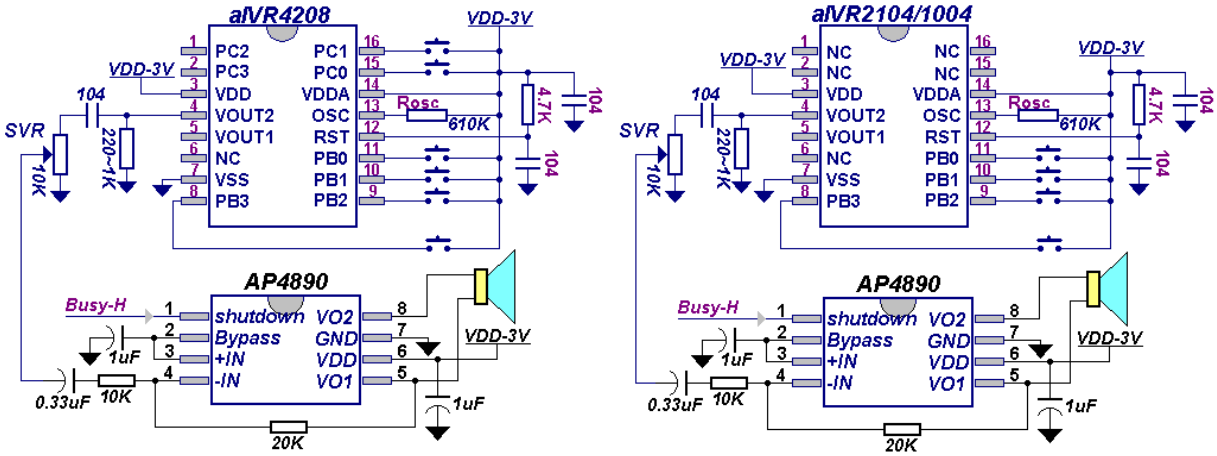
Output Options must be selection [Option-3] , the OUT2=Busy-H



	OUT1	OUT2	OUT3
Option-1 :	LED1	LED2	BUSY
Option-2 :	STOP	LED1	LED2
Option-3 :	LED1	BUSY	STOP

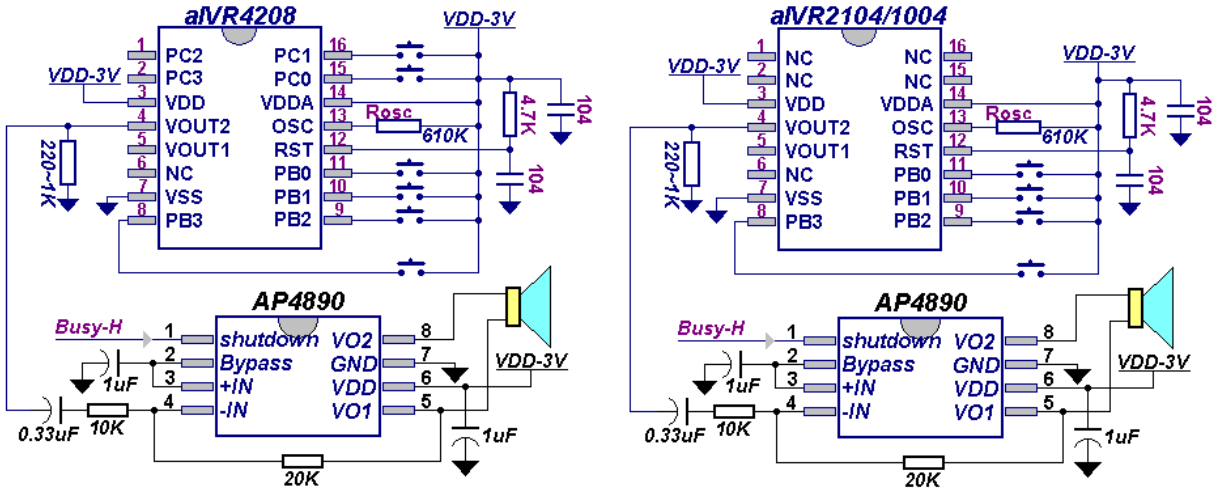
Output Options must be selection [Option-3] , the OUT2=Busy-H

- ***Application for VOICE OTP --- aIVRxx series IC & SVR volume adjust :***

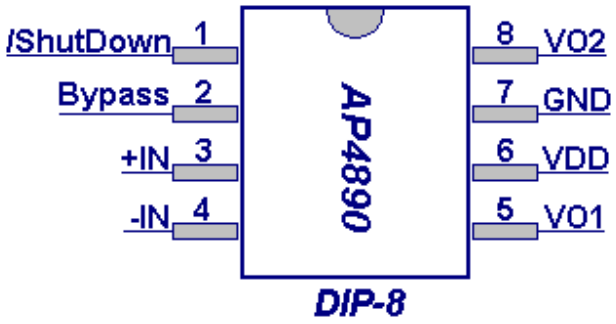


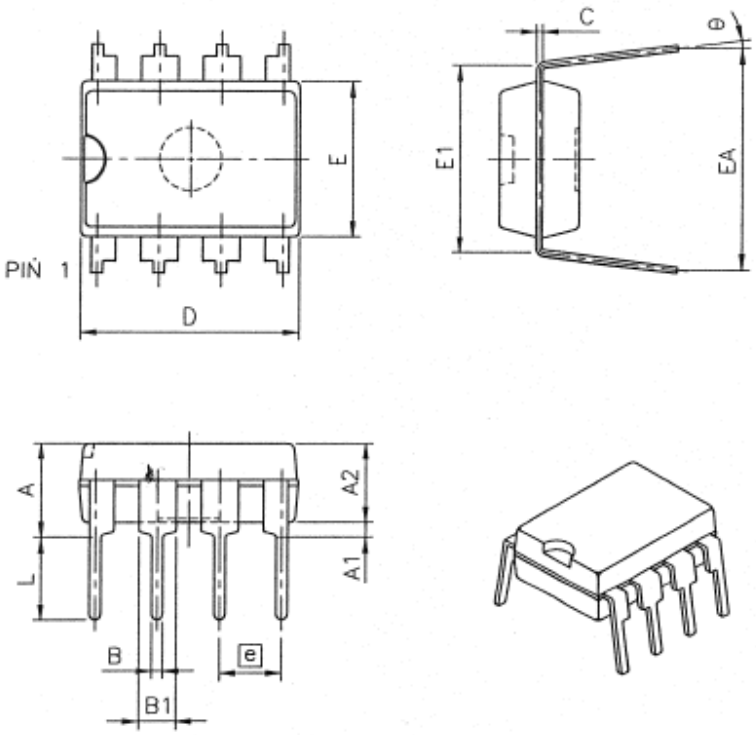
*PS : The aIVRxx series IC must be output [**Busy-H**] to control the shutdown pin of AP4890 IC for standby current control*

- ***Application for VOICE OTP --- aIVRxx series IC :***



PACKAGE : DIP-8





SYMBOL	DIMENSION IN INCH	DIMENSION IN MM
A	0.170 MAX.	4.318 MAX.
A1	0.015 MIN.	0.381 MIN.
A2	0.130±0.005	3.302±0.127
B	0.018 TYP.	0.457 TYP.
B1	0.060 TYP.	1.524 TYP.
C	0.010 NOM.	0.254 NOM.
D	0.362±0.005	9.195±0.127
E	0.252±0.005	6.401±0.127
E1	0.300±0.010	7.62±0.254
EA	0.355±0.020	9.017±0.508
e	0.100 TYP.	2.540 TYP.
L	0.130±0.010	3.302±0.254
θ	0°~15°	0°~15°

NOTE: 1.DIMENSION D & E DOES NOT INCLUDE FLASH.

- **REVISION HISTORY :**

Date	Revision #	Description	Page
Feb.17.2009	1.1	First Release	
Feb. 26.2009	1.2	Add AP89xx & aIVRxx series VOICE IC application circuit	7~11
Mar. 05 . 2009	1.3	Modify AP4890 Rf=39K → 20K & **Rin=20K → 10K & Cin=0.39uF → 0.33uF**	7 ~ 11