

# CTL recording / playback amplifier for VHS VCRs

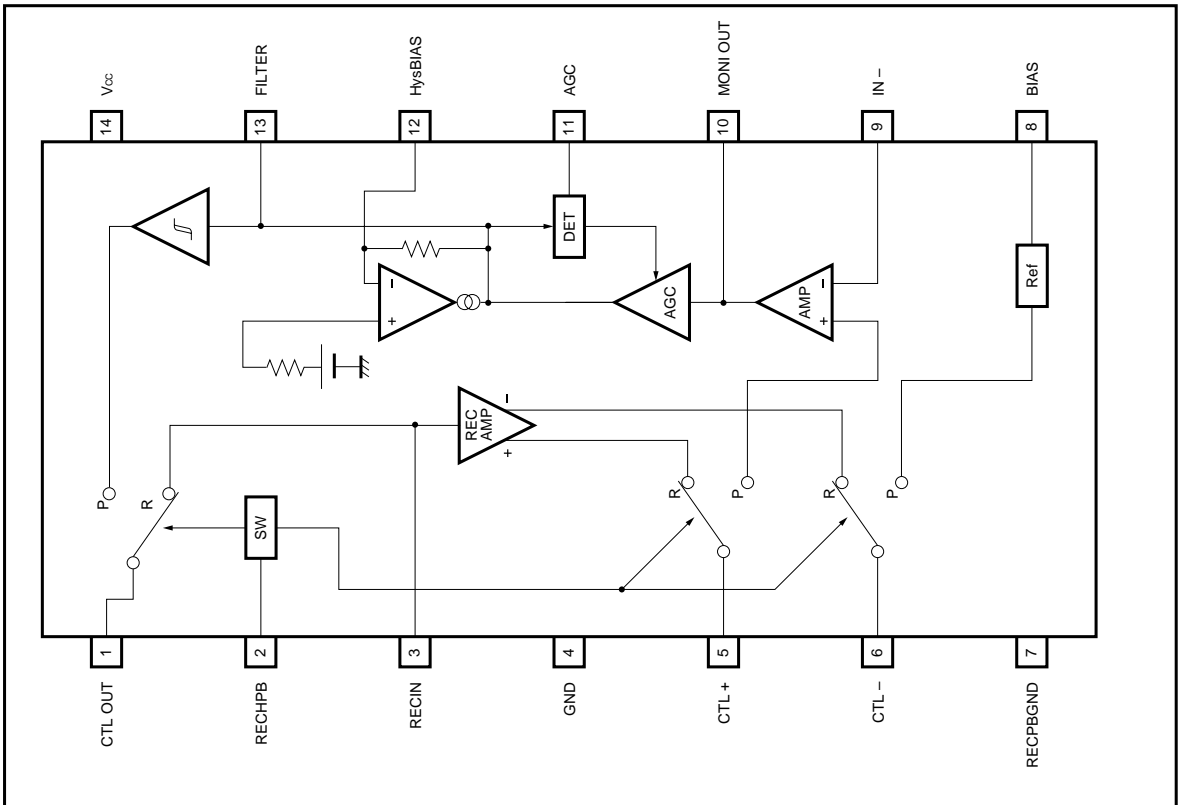
## BA8400FV

The BA8400FV is a CTL recording / playback amplifier developed for VHS VCRs. The playback amplifier has an AGC circuit that can handle large input signal fluctuations, and a recording / playback switching circuit is provided to allow high-speed switching.

●Applications  
VHS-format VCRs

- Features
- 1) Can be operated off low power supply voltage (2.7V to 3.5V).
  - 2) Playback amplifier with AGC.
  - 3) Fast switching between recording and playback.

●Block diagram



## ●Pin descriptions

Pin No.	Pin name	Function
1	CTL OUT (CTL pulse output)	CTL pulse output. High output level approx. $V_{CC} - 0.05V$ , $I_o = +0.5mA$ Low output level approx. $0.05V$ , $I_o = -0.5mA$
2	RECHPB (record / play switch)	Switch input pin for the record / playback amplifiers. High input: REC mode Low input: PB mode Threshold voltage: approx. $1 / 2V_{CC}$
3	RECIN (REC CTL pulse input)	CTL pulse input pin for recording. Threshold voltage: approx. $1 / 2V_{CC}$
4	GND	Power, REC / PB SW, CTL output buffer ground pin.
5	CTL + (CTL head "+" input)	When recording: CTL head positive-side recording current. When playing: input pin for the playback CTL pulse.
6	CTL - (CTL head "-" input)	When recording: CTL head negative-side recording current. When playing: bias pin for the playback CTL pulse input.
7	RECPBGND	Ground pin for the REC and playback amplifiers.
8	BIAS (bias)	Bias pin for the playback amplifier. Bias voltage: $V_{IB8} = 0.15V_{CC} + 1.3V$ (approx.)
9	IN - (playback amplifier input)	Feedback input pin for the playback amplifier.
10	MONIOUT (playback amplifier output)	Playback amplifier output monitor pin. Output dynamic range is the DC level $\pm V_f$ .
11	AGC (AGC time constant)	Set the time constant after considering the transient response of the playback mode switching. AGC detect level $V_{detAGC} = 0.47V_{CC}$ [V] (approx.) Playback amplifier output amplitude $V_{AGC} = 2 \times (V_{detAGC} - HysV_{cent})$ [ $V_{P-P}$ ]
12	HysBIAS (hysteresis amplifier center level)	Connection pin for the bypass capacitor for the hysteresis amplifier center level.
13	FILTER (high-frequency noise filter)	Pin for connection of high-frequency noise filter for AGC amplifier output for playback CTL pulse. Also, input pin for the hysteresis amplifier. Hysteresis amplifier center voltage $HysV_{cent} = 0.27V_{CC}$ [V] approx. High-side hysteresis width $\Delta HysV_H = 0.367V_{CC} - HysV_{cent}$ [V] Low-side hysteresis width $\Delta HysV_L = 0.173V_{CC} - HysV_{cent}$ [V]
14	$V_{CC}$	Connect a decoupling capacitor close to the pin.

●Absolute maximum ratings ( $T_a = 25^\circ C$ )

Parameter	Symbol	Limits	Unit
Power supply voltage	$V_{CC}$	8.0	V
Power dissipation	$P_d$	450*	mW
Operating temperature	$T_{opr}$	-25 ~ +75	$^\circ C$
Storage temperature	$T_{stg}$	-55 ~ +125	$^\circ C$

\* Reduced by 4.5mW for each increase in  $T_a$  of  $1^\circ C$  over  $25^\circ C$ .

●Recommended operating conditions ( $T_a = 25^\circ C$ )

Parameter	Symbol	Limits	Unit
Applied voltage	$V_{CC}$	2.7 ~ 3.5	V

○Not designed for radiation resistance.

● Input / output circuits

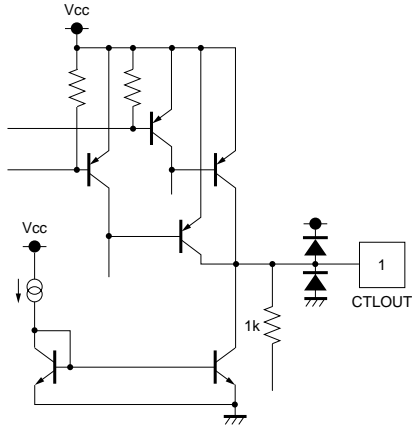


Fig.1

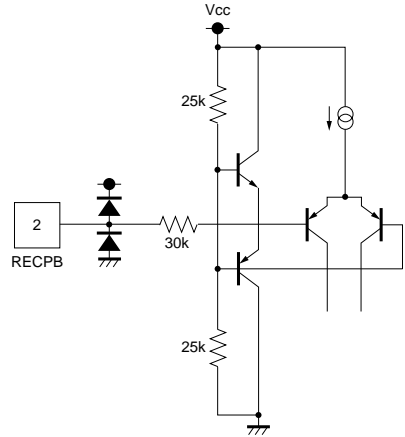


Fig.2

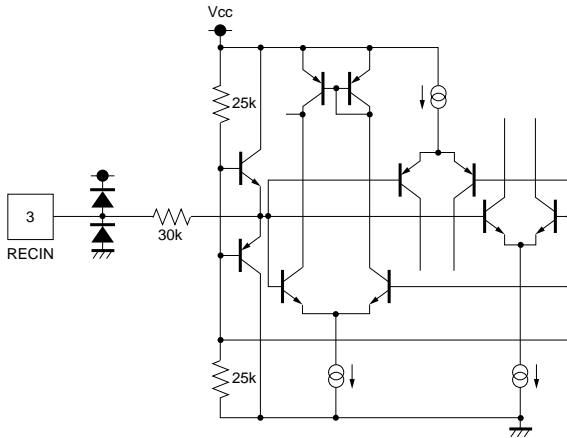


Fig.3

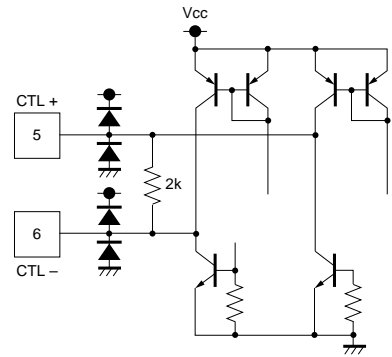


Fig.4

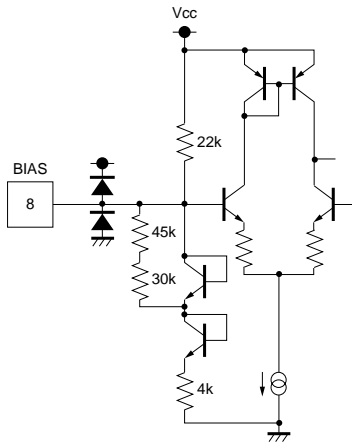


Fig.5

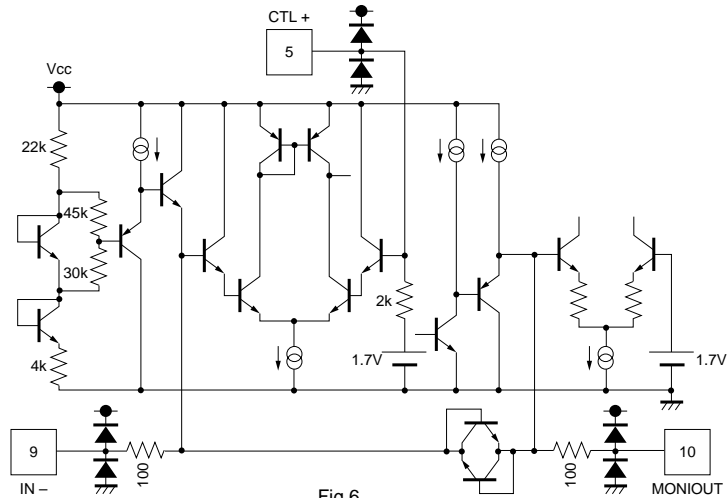


Fig.6

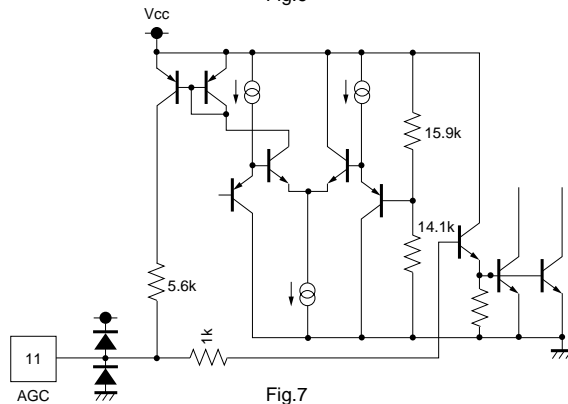


Fig.7

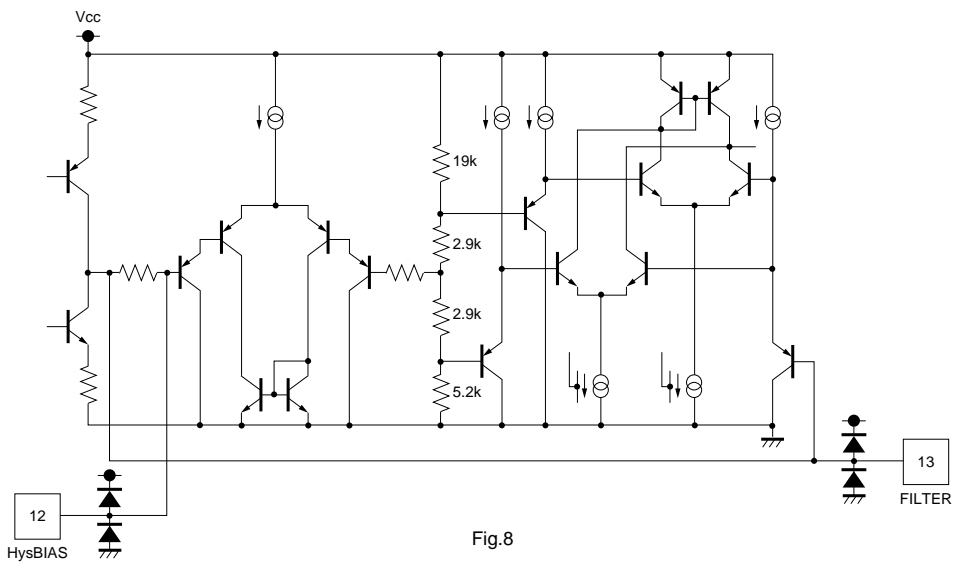


Fig.8

●Electrical characteristics (unless otherwise noted, Ta = 25°C and V<sub>CC</sub> = 3V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Circuit current	I <sub>CC</sub>	—	3.5	7.0	mA	No signal, CTLOUT: High
〈AGC amplifier〉						
AGC amplifier gain	G <sub>VAGC</sub>	2.5	4.5	6.5	dB	—
Input bias voltage	V <sub>IB8</sub>	1.35	1.7	2.05	V	—
Pin 5 input resistance	Z <sub>IN5</sub>	1.6	2.0	2.4	kΩ	—
AGC control sensitivity	ΔAGC / V	-2	0	+2	dB	V <sub>IN</sub> = 0.15→1.0V <sub>P-P</sub>
Output amplitude	V <sub>AGC</sub>	0.88	1.1	1.32	V <sub>P-P</sub>	f = 300Hz, V <sub>IN</sub> = 300mV <sub>P-P</sub>
〈Hysteresis amplifier〉						
Hysteresis width	ΔHysV	± 250	± 290	± 330	mV	—
CTLOUT output high level voltage	VOHP	2.0	2.8	—	V	I <sub>O</sub> = -0.5mA
CTLOUT output low level voltage	VOLP	—	0.2	1.0	V	I <sub>O</sub> = +0.5mA
〈REC amplifier〉						
Recording current	I <sub>REC</sub>	± 1.3	± 2.5	± 3.7	mA	R <sub>O</sub> = 400 Ω
Max. output high level voltage	VOHR	2.0	2.8	—	V	I <sub>O</sub> = -0.5mA
Max. output low level voltage	VOLR	—	0.2	1.0	V	I <sub>O</sub> = +0.5mA
Threshold voltage	V <sub>th3</sub>	1.0	1.5	2.0	V	—
Input resistance	Z <sub>IN3</sub>	24	30	36	kΩ	—
〈REC / PB switch〉						
Threshold voltage	V <sub>th2</sub>	1.0	1.5	2.0	V	—
REC to PB switching time	TR - P	—	—	100	ms	*See note below

\* Note: The switching time from REC to PB is the time until CTLOUT is output.

● Measurement circuit

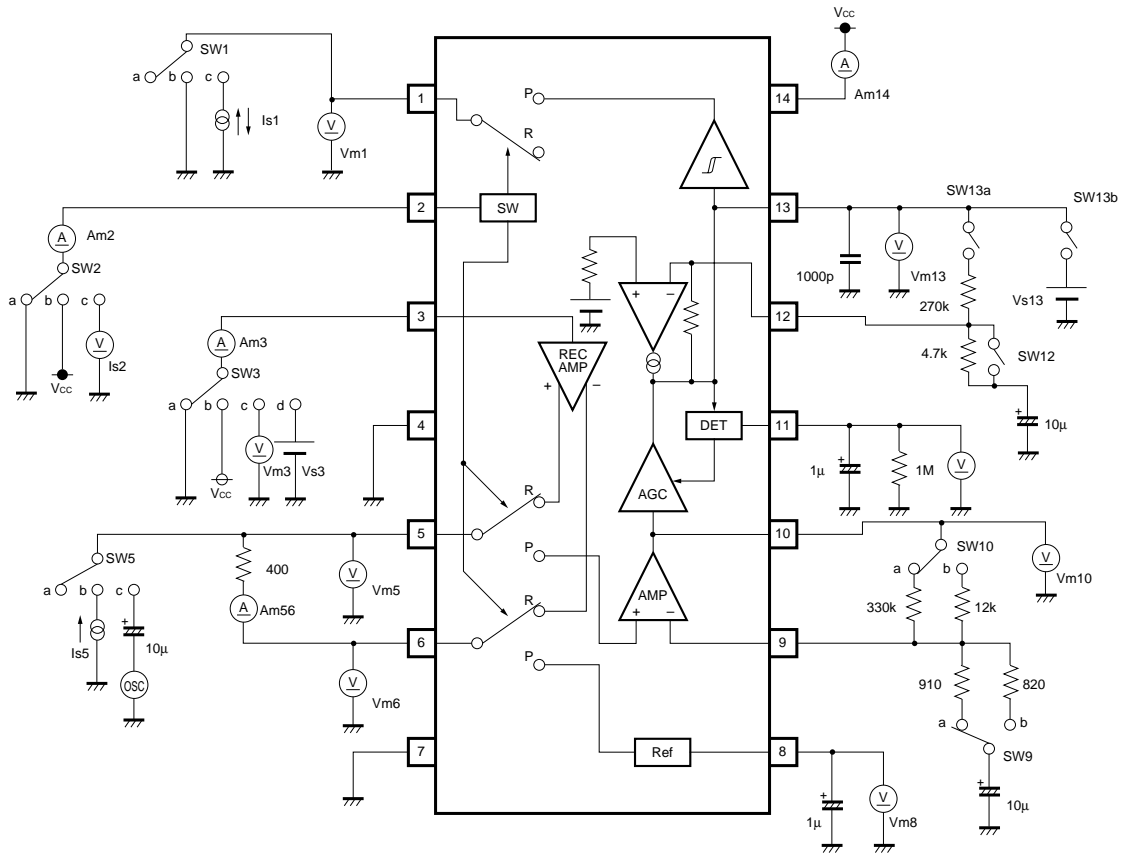


Fig.9

● Measurement conditions (unless otherwise noted,  $T_a = 25^\circ\text{C}$  and  $V_{CC} = 3\text{V}$ )

Parameter	Symbol	Monitor	Switch position									Notes
			SW 1	SW 2	SW 3	SW 5	SW 9	SW 10	SW 12	SW 13a	SW 13b	
Circuit current (AGC amplifier)	$I_{CC}$	Am14	a	a	a	a	a	a	ON	OFF	OFF	—
AGC amplifier gain	GVagc	Vm13	a	a	a	c	b	b	OFF	ON	OFF	*1. $f = 300\text{Hz}$ , $V_{IN} = 50\text{mV}_{P-P}$
Input bias voltage	VIB8	Vm8	a	a	a	a	a	a	ON	OFF	OFF	—
Pin 5 input resistance	$Z_{IN5}$	Vm5	a	b	b	b	a	a	ON	OFF	OFF	*2.
AGC control sensitivity	$\Delta\text{AGC} / V$	13pin	a	a	a	c	a	b	ON	OFF	OFF	*3. $f = 300\text{Hz}$ , $V_{IN} = 0.15 / 1.0\text{V}_{P-P}$
Output amplitude (Hysteresis amplifier)	VAGC	13pin	a	a	a	c	a	b	ON	OFF	OFF	*4. $f = 300\text{Hz}$ , $V_{IN} = 300\text{mV}_{P-P}$
Hysteresis width	$\Delta\text{HysV}$	Vm1	a	a	a	a	a	a	ON	OFF	b	*5.
CTLOUT output voltage H	VOHP	Vm1	c	a	a	a	a	a	ON	OFF	b	$I_o = -0.5\text{mA}$ , $V_{S13} = 1.5\text{V}$
CTLOUT output voltage L	VOLP	Vm1	c	a	a	a	a	a	ON	OFF	b	$I_o = +0.5\text{mA}$ , $V_{S13} = 0\text{V}$
Recording current 5	Irec5	Am56	a	b	b	a	a	a	ON	OFF	OFF	—
Recording current 6	Irec6	Am56	a	b	a	a	a	a	ON	OFF	OFF	—
Max. output voltage "H"	VOHR	Vm1	c	b	b	a	a	a	ON	OFF	OFF	$I_o = -0.5\text{mA}$
Max. output voltage "L"	VOLR	Vm1	c	b	a	a	a	a	ON	OFF	OFF	$I_o = +0.5\text{mA}$
Input threshold voltage	Vth3	Vm3	a	b	c	a	a	a	ON	OFF	OFF	—
Input resistance (REC / PB switch)	$Z_{IN3}$	Vm3	a	b	d	a	a	a	ON	OFF	OFF	*6.
Threshold voltage	Vth2	Vm2	a	c	a	a	a	a	ON	OFF	OFF	—
REC to PB switching time	TR-P	1pin	a	ba	a	c	a	a	ON	OFF	OFF	*6.

## Measurement method

- \*1 Input a sine wave of  $f = 300\text{Hz}$  to pin 5, and measure the output amplitudes on pins 10 and 13 ( $V_{o10}$  and  $V_{o13}$ ).  
The AGC gain is given by:  $G_{\text{vagc}} = 20\log(V_{o13} / V_{o10})$  [dB].
- \*2 Measure the output voltages  $V_{o0}$  and  $V_{o.5}$  on pin 5 when currents of  $I_{S5} = 0$ , and  $I_{S5} = 0.5\text{mA}$  are applied.  
The input resistance is given by:  $Z_{IN5} = \{0.0005 / (V_{o.5} - V_{o0}) / 400\}^{-1}$  [ $\Omega$ ]
- \*3 Input a sine wave of  $f = 300\text{Hz}$  to pin 5. Adjust the input level until the output amplitude on pin 10 is  $0.15V_{P-P}$  and  $1.0V_{P-P}$ , and measure the corresponding output amplitudes on pin 13 ( $V_{o0.15}$  and  $V_{o1.0}$ ).  
The AGC control sensitivity is given by:  $\Delta\text{AGC} / V = 20\log(V_{o1.0} / V_{o0.15})$  [dB].
- \*4 Input a sine wave of  $f = 300\text{Hz}$  to pin 5. Adjust the input level until the output amplitude on pin 10 is  $300\text{mV}_{P-P}$ .  
Measure the output amplitude on pin 13.
- \*5 With pin 13 floating, measure the output voltage  $V_{ocent}$ .  
Increase  $V_{S13}$  from  $0\text{V}$ , and record  $V_{inH}$  as the  $V_{S13}$  voltage when the pin 1 output exceeds  $2.8\text{V}$ .  
Decrease  $V_{S13}$  from  $1.5\text{V}$ , and record  $V_{inL}$  as the  $V_{S13}$  voltage when the pin 1 output goes below  $0.2\text{V}$ .  
High-side hysteresis width  $\Delta\text{HysVH} = V_{inH} - V_{ocent}$  [ $V_{P-P}$ ]  
Low-side hysteresis width  $\Delta\text{HysVL} = V_{inL} - V_{ocent}$  [ $V_{P-P}$ ]
- \*6 Measure the currents  $I_{in2.7}$  and  $I_{in3.0}$  on pin 3 when voltages  $V_{S3}$  of  $2.7\text{V}$  and  $3.0\text{V}$  respectively are applied.  
The input resistance is given by:  $Z_{IN3} = 0.3 / (I_{in3.0} - I_{in2.7})$  [ $\Omega$ ]
- \*7 Input a square wave of  $300\text{Hz}$ ,  $V_{IN} = 20\text{mV}_{P-P}$  to pin 5, and measure the time that it takes CTLOUT to be output after pin 2 goes from  $V_{CC}$  to  $0\text{V}$ .

●Application example

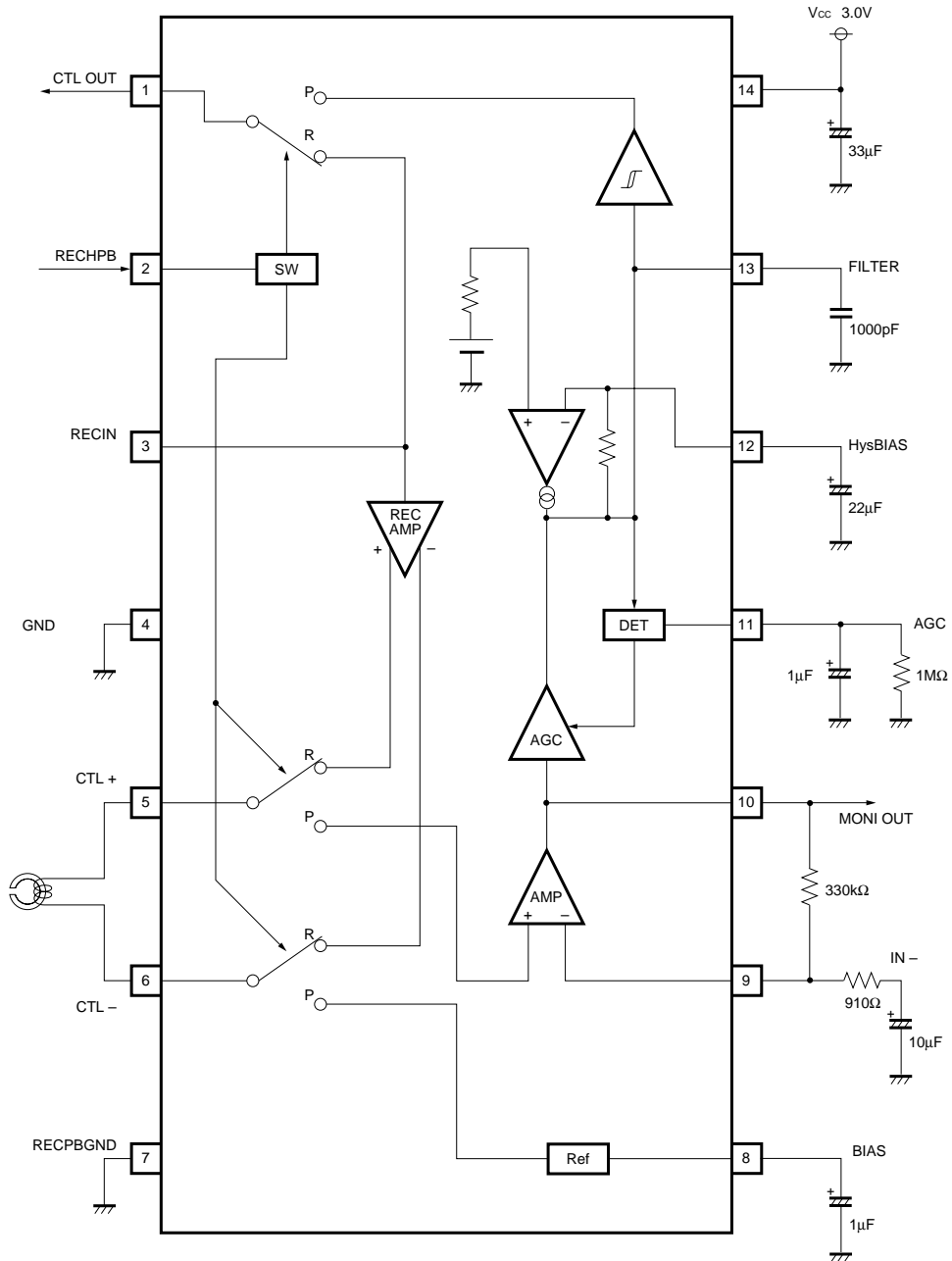


Fig.10



●External dimensions (Units: mm)

