

High-voltage control circuit for CRT displays

BA9756 / BA9756FS

The BA9756 / BA9756FS are LSIs that control CRT anode voltage in multi-scan monitors and similar devices, using a chopper-type voltage control circuit. The internal sawtooth wave generator circuit uses automatic gain control (AGC) to enable coverage of a wide range from 30kHz to over 150kHz. The BA9756FS is equipped with an internal high-precision voltage source featuring an output voltage precision of $\pm 0.7\%$.

●Applications

CRT displays, HDTVs, others

●Features

- 1) Internal chopper-type voltage control circuit.
- 2) Internal buffer circuit enables direct drive of power MOSFET for output drive.
- 3) Internal high-precision voltage source offers output voltage precision of $\pm 0.7\%$ (1.5% for the BA9756).

●Absolute maximum ratings (Ta = 25°C)

Parameter		Symbol	Limits	Unit
Power supply voltage 1		V _{cc1}	18	V
Power supply voltage 2		V _{cc2}	20	V
Power dissipation	BA9756	Pd	950 ^{*1}	mW
	BA9756FS		750 ^{*2}	
Operating temperature		T _{opr}	– 25 ~ + 80	°C
Storage temperature		T _{stg}	– 55 ~ +125	°C

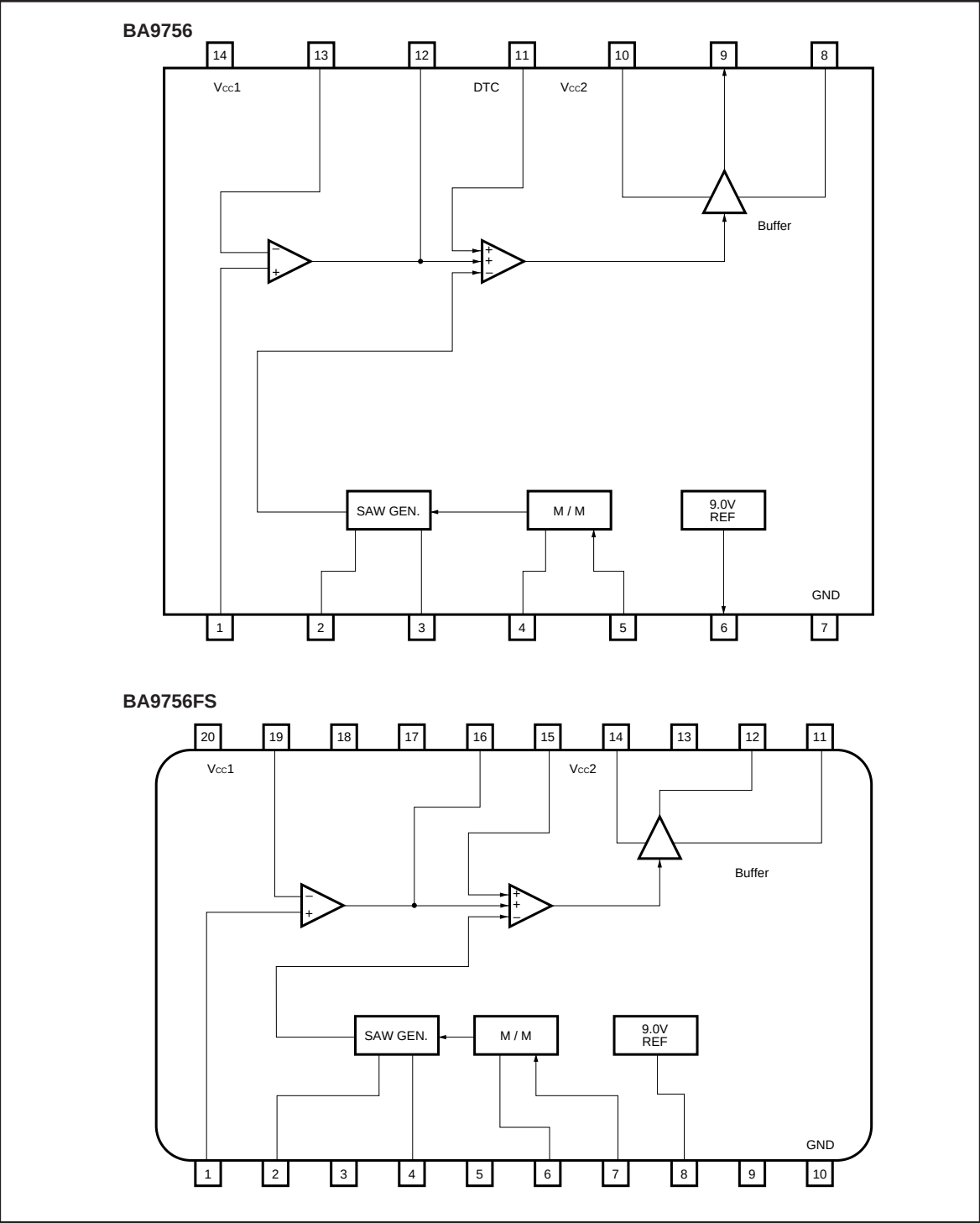
*1 Reduced by 9.5mW for each increase in Ta of 1°C over 25°C.

*2 When mounted on a 70mm × 70mm × 1.6mm glass epoxy board.
Reduced by 7.5mW for each increase in Ta of 1°C over 25°C.

●Recommended operating conditions (Ta = 25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage 1	V _{cc1}	11	—	17	V
Power supply voltage 2	V _{cc2}	11	—	17	V

●Block diagram



● Pin descriptions

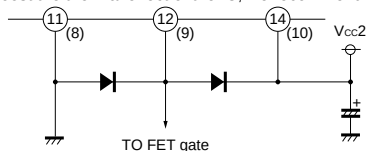
Items in parentheses are for the BA9756.

Pin No.	Pin name	Function
1	ERRIN (error amplifier + input)	This is the recovery voltage input pin.
2	AGC (constant for AGC)	Capacitance should be determined taking into consideration the linearity at the minimum oscillation frequency, and the response time when the frequency changes.
3	N.C.	See*1.
4 (3)	SAWOUT (constant for sawtooth wave)	This is the output pin for optimized sawtooth waves, based on the maximum oscillation frequency. fMax120kHz C = 1000pF fMax100kHz C = 1200pF fMax 80kHz C = 1500pF fMax 60kHz C = 2000pF
5	N.C.	See*1.
6 (4)	MMCR (delay constant for monostable multivibrator)	A charging resistance of 4.7kΩ or higher should be used. The threshold level is 4.5V.
7 (5)	HDIN (Hd pulse input)	The threshold level is approximately 2.1V.
8 (6)	VREF9 (Ref 9V output)	An output deviation of ± 0.7% is assured through trimming (± 1.5% for the BA9756).
9	N.C.	See*1.
10 (7)	GND (Signal GND)	This may be shared with the power GND, but make sure sufficiently stable grounding is provided.
11 (8)	GND (Power GND)	This may be shared with the signal GND, but make sure sufficiently stable grounding is provided.
12 (9)	PWMOUT (PWM output)	If a voltage of less than GND or higher than V _{CC} is applied because of external back electromotive force, a protective diode should be inserted (*2). If the protector circuit and thermal shutdown circuit are tripped, output is fixed at high (V _{CC}) level.
13	N.C.	See*1.
14 (10)	V _{CC} 2 (Power V _{CC})	A decoupling capacitor should be positioned in the vicinity of this pin.
15 (11)	DTC IN (dead time control input)	The voltage input to this pin enables restriction of the PWM output duty. The duty control is between 0V and 9V, and approximately 0% to 100% is enabled. At 0V, however, restrictions apply. The minimum pulse width for the PWM is 0.85μs (Typ. at 90kHz).
16 (12)	ERROUT (error amplifier output)	This is the output pin for the error amplifier.
17	N.C.	See*1.
18	N.C.	See*1.
19 (13)	ERRREF (error amplifier input)	This is the input pin for the reference voltage.
20 (14)	V _{CC} 1 (signal V _{CC})	A decoupling capacitor should be positioned in the vicinity of this pin.

*1 N.C. pin processing

In order to boost the thermal effect of the IC, we recommend connecting this to the GND or to an adjacent pin.

*2



● Input / output circuits

Items in parentheses are for the BA9756.

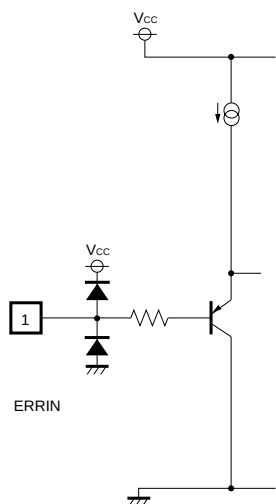


Fig.1

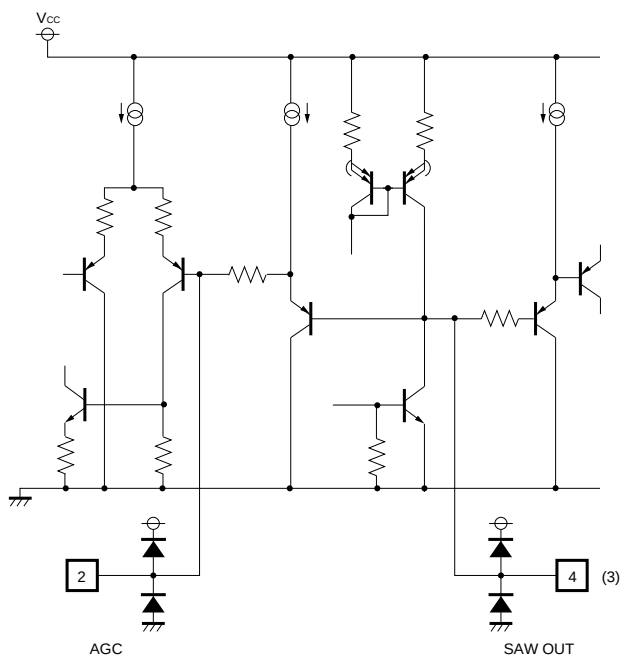


Fig.2

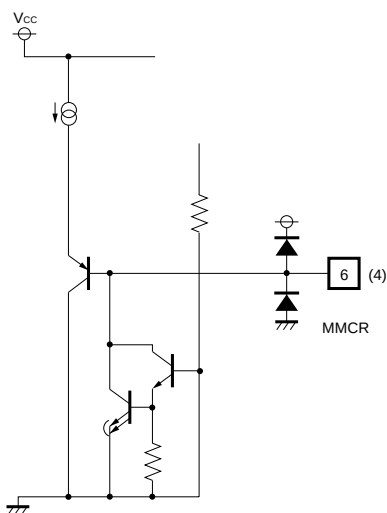


Fig.3

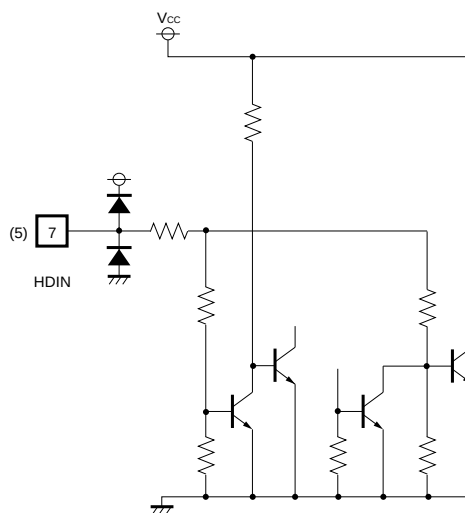


Fig.4

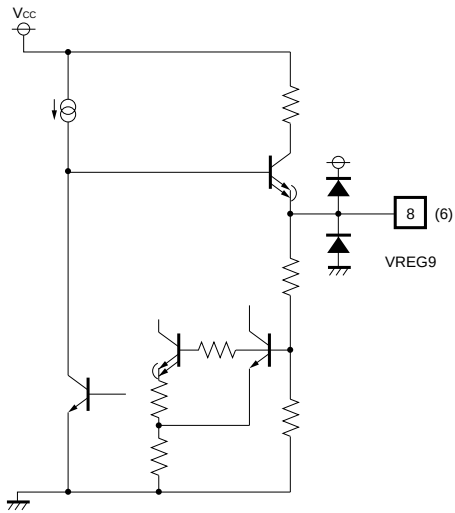


Fig.5

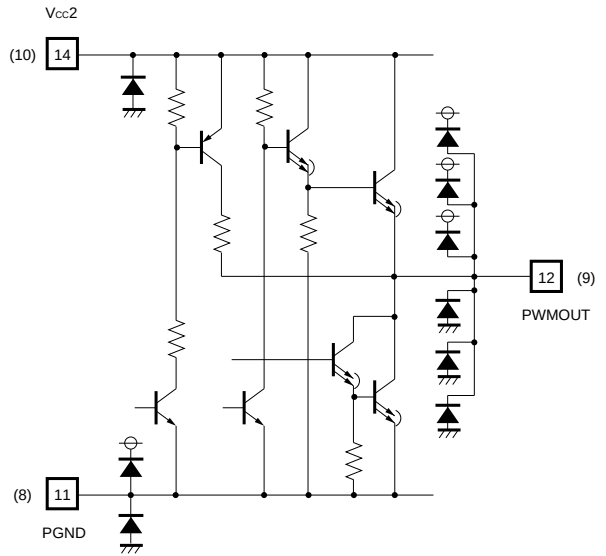


Fig.6

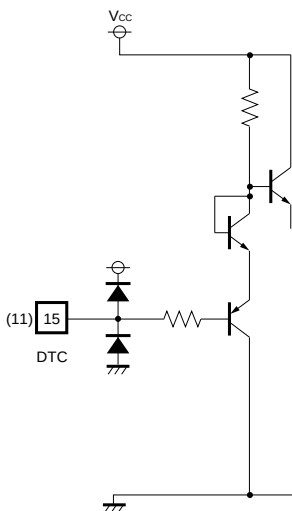


Fig.7

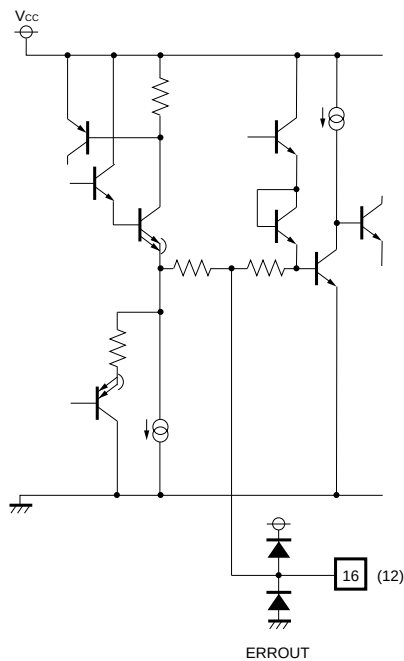


Fig.8

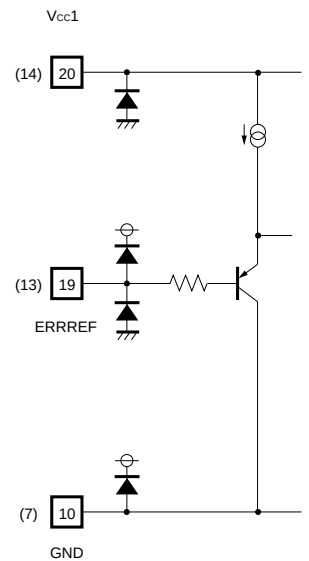


Fig.9

●Electrical characteristics (unless otherwise noted, Ta = 25°C, Vcc = 15V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
〈Hd input pin〉						
Input high level voltage	V _{IH}	3.0	—	V _{CC}	V	—
Input low level voltage	V _{IL}	—	—	1.5	V	—
Input high level current	I _{IH}	—	360	530	μA	V _{IN} = 15V
Input low level current	I _{IL}	—	0	− 1	μA	—
〈Monostable multivibrator〉						
Delay time	T _{dl}	1.80	2.15	2.50	μs	R = 10kΩ, C = 220pF
〈SAW GEN〉						
Output high level	H _{OS}	8.0	9.0	10.0	V	—
Output low level	L _{OS}	0	0.15	0.35	V	—
Output level f characteristic	f _{SAW}	150	200	—	kHz	− 1dB drop from 30kHz
〈Reference voltage supply〉						
Output voltage	V _{REF9}	8.865	9.0	9.135	V	BA9756
		8.937	9.0	9.063	V	BA9756FS
Max. output current	I _{rmax9}	10	—	—	mA	—
Output voltage thermal characteristics	T _{REF9}	—	± 0.1	± 0.3	%	Guaranteed design parameter at Ta = 25→0°C, 25→75°C
Thermal shutdown	T _{dow}	100	—	—	deg	Guaranteed design parameter

● Measurement circuits
(For the BA9756FS)

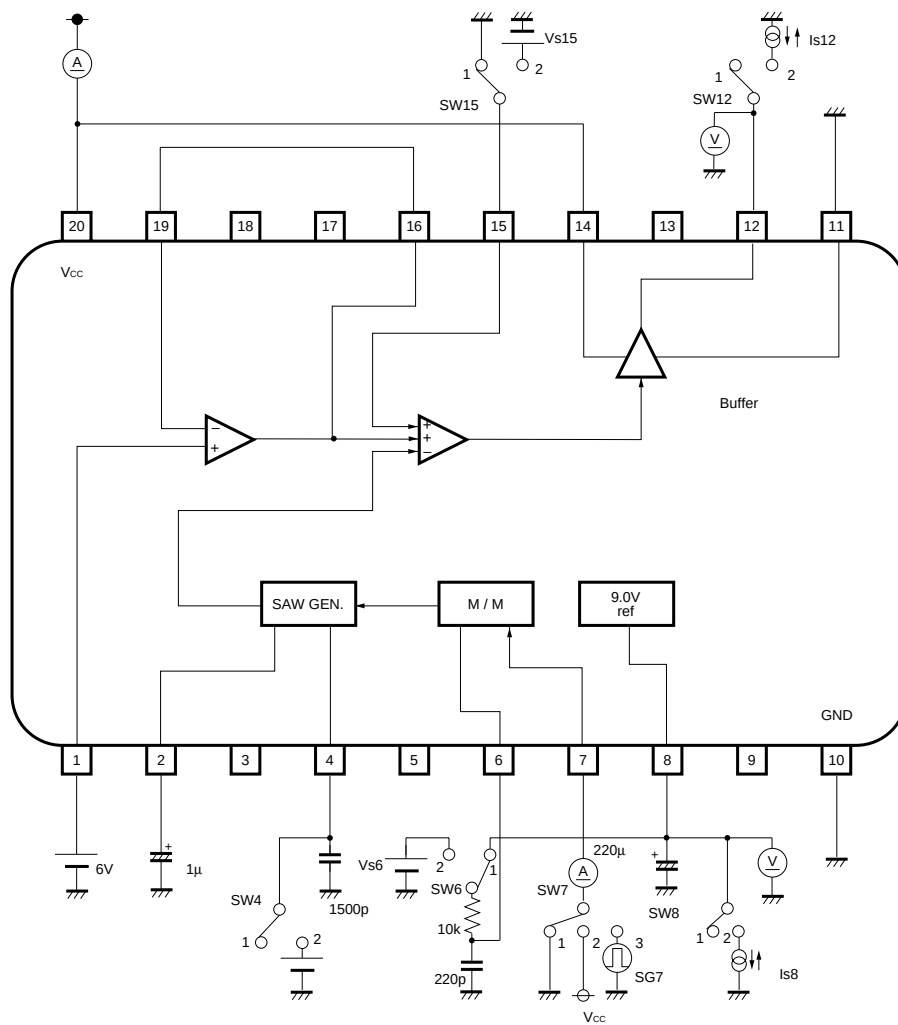


Fig.10

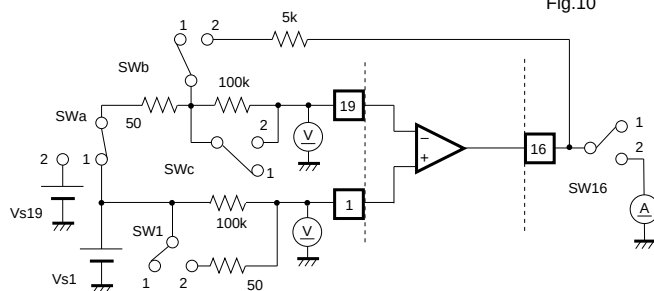


Fig.11

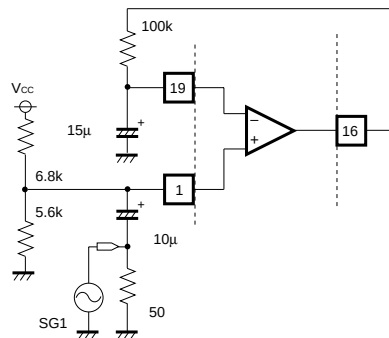


Fig.12

● Measurement conditions (unless otherwise noted, Ta = 25°C, Vcc = 15V)

Parameter	Symbol	Switch position											Conditions
		SW1	SW3	SW4	SW5	SW6	SW9	SW11	SW12	SWa	SWb	SWc	
Circuit current	I _{CC}	—	1	1	1	1	1	1	—	—	—	—	—
(Error amplifier)													
Input bias current	I _B	1	1	1	1	1	1	1	1	1	1	1	Vs1 = 6V, I _B = - V _{IN} × 10 ⁻⁵
Input offset voltage	V _{IO}	1	1	1	1	1	1	1	1	2	2	2	Vs1 = 6V, V _{IO} = (V _{I2} - 6) × 10 ⁻²
Output low level voltage	V _{OL}	1	1	1	1	1	1	1	1	2	1	1	Vs1 = 5V, Vs13 = 6V
Output high level voltage	V _{OH}	1	1	1	1	1	1	1	1	2	1	1	Vs1 = 7V, Vs13 = 6V
Open voltage gain	AV	—	1	1	1	1	1	1	—	—	—	—	SG1: f = 1kHz, V _{IN} = 10mV _{P-P}
Max. output current	I _{OM}	1	1	1	1	1	1	1	2	2	1	1	Vs1 = 7V, Vs13 = 6V *1
(PWM amplifier)													
Output high level voltage	V _{OH}	—	2	1	1	1	2	2	—	—	—	—	Vs3 = 6V, Vs11 = 5V, Is9 = - 100mA
Output low level voltage	V _{OL}	—	2	1	1	1	2	2	—	—	—	—	Vs3 = 6V, Vs11 = 7V, Is9 = ± 100mA
Rise time	Tr	—	1	1	3	1	1	1	—	—	—	—	SG5: f = 90kHz *2
Fall time	Td	—	1	1	3	1	1	1	—	—	—	—	SG5: f = 90kHz *2
Min. pulse width	TMin	—	1	1	3	1	1	1	—	—	—	—	SG5: f = 90kHz *2
(HD input pin)													
Input high level voltage	V _{IH}	—	1	1	3	1	1	1	—	—	—	—	SG5: f = 90kHz *2
Input low level voltage	V _{IL}	—	1	1	3	1	1	1	—	—	—	—	SG5: f = 90kHz *2
Input high level current	I _{IH}	—	1	1	2	1	1	1	—	—	—	—	—
Input low level current	I _{IL}	—	1	1	1	1	1	1	—	—	—	—	—
(Monostable multivibrator)													
Delay time	T _{dl}	—	1	2	3	1	1	1	—	—	—	—	SG5: f = 90kHz, Vs4 = 9V *2
(SAW GEN)													
Output high level	H _{OS}	—	1	1	3	1	1	1	—	—	—	—	SG5: f = 90kHz *2
Output low level	L _{OS}	—	1	1	3	1	1	1	—	—	—	—	SG5: f = 90kHz *2
Output level f characteristic	fsaw	—	1	1	3	1	1	1	—	—	—	—	SG5: f = 30kHz *3
(Reference voltage supply)													
Output voltage	V _{REF9}	—	1	1	1	1	1	1	—	—	—	—	—
Max. output current	I _{max9}	—	1	1	1	2	1	1	—	—	—	—	Is = - 10mA
Output voltage thermal characteristic	T _{REF9}	—	1	1	1	1	1	1	—	—	—	—	Ta = 0°C→75°C
Thermal shutdown	T _{dow}	—	1	1	1	1	1	1	—	—	—	—	Ta = 75°C *4

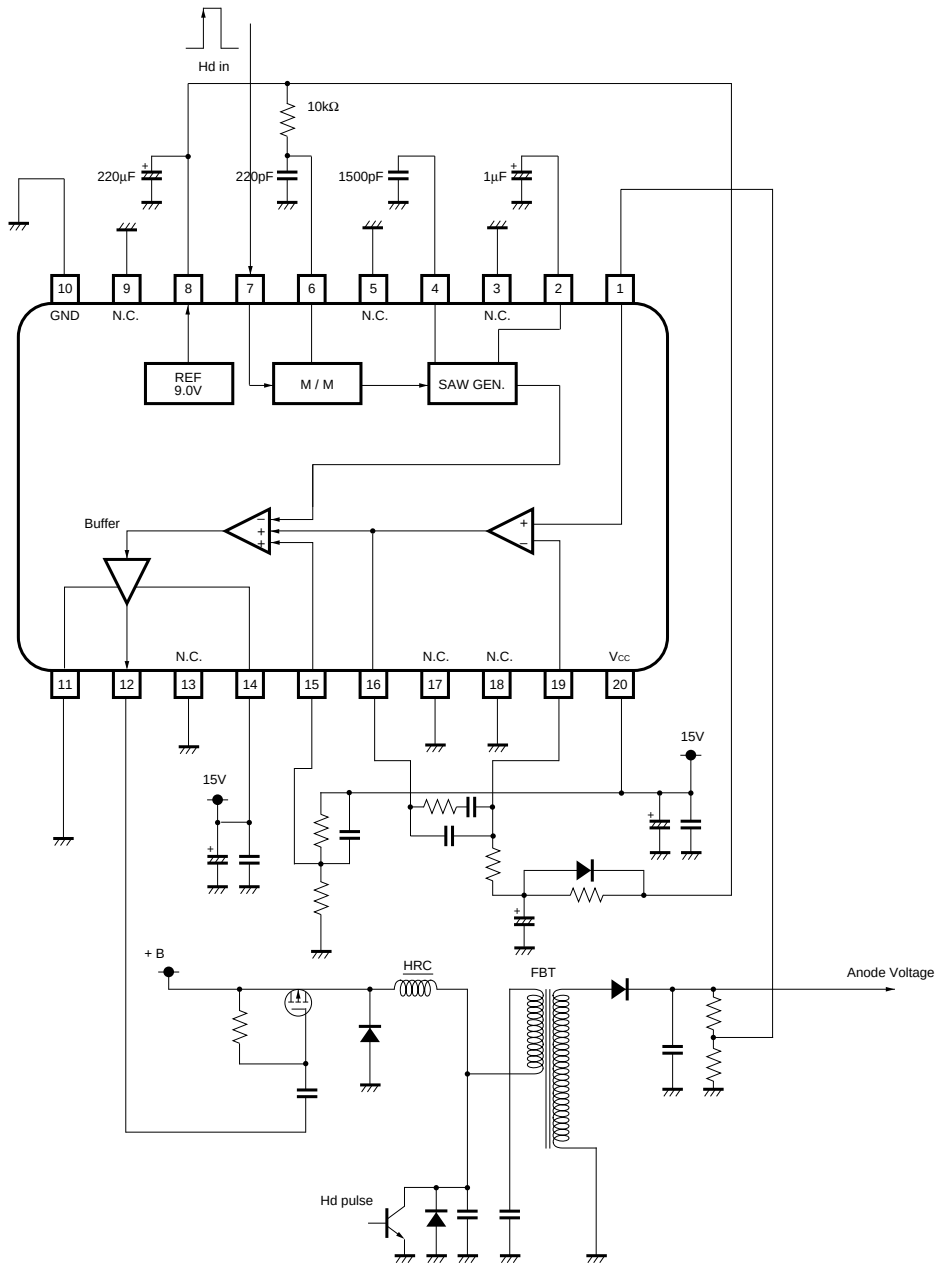
*1 The pin 12 output amplitude should be set to V_O. AV = 20log (V_O / V_{IN}) [dB]

*2 For the method by which the output waveform is determined, refer to Fig. 14.

*3 An input frequency should be measured that produces a level of - 1dB for a high output level (H_{OS}) for the sawtooth waveform at an input frequency of 30kHz.

*4 The temperature is measured at the point where the temperature is raised to above Ta = 75°C and the output level of pin 9 is high.

●Application example
(BA9756FS)



Note: N.C. pin processing

In order to boost the thermal effect of the IC, we recommend connecting this to the GND or to an adjacent pin.

Fig.13

Input / output waveforms

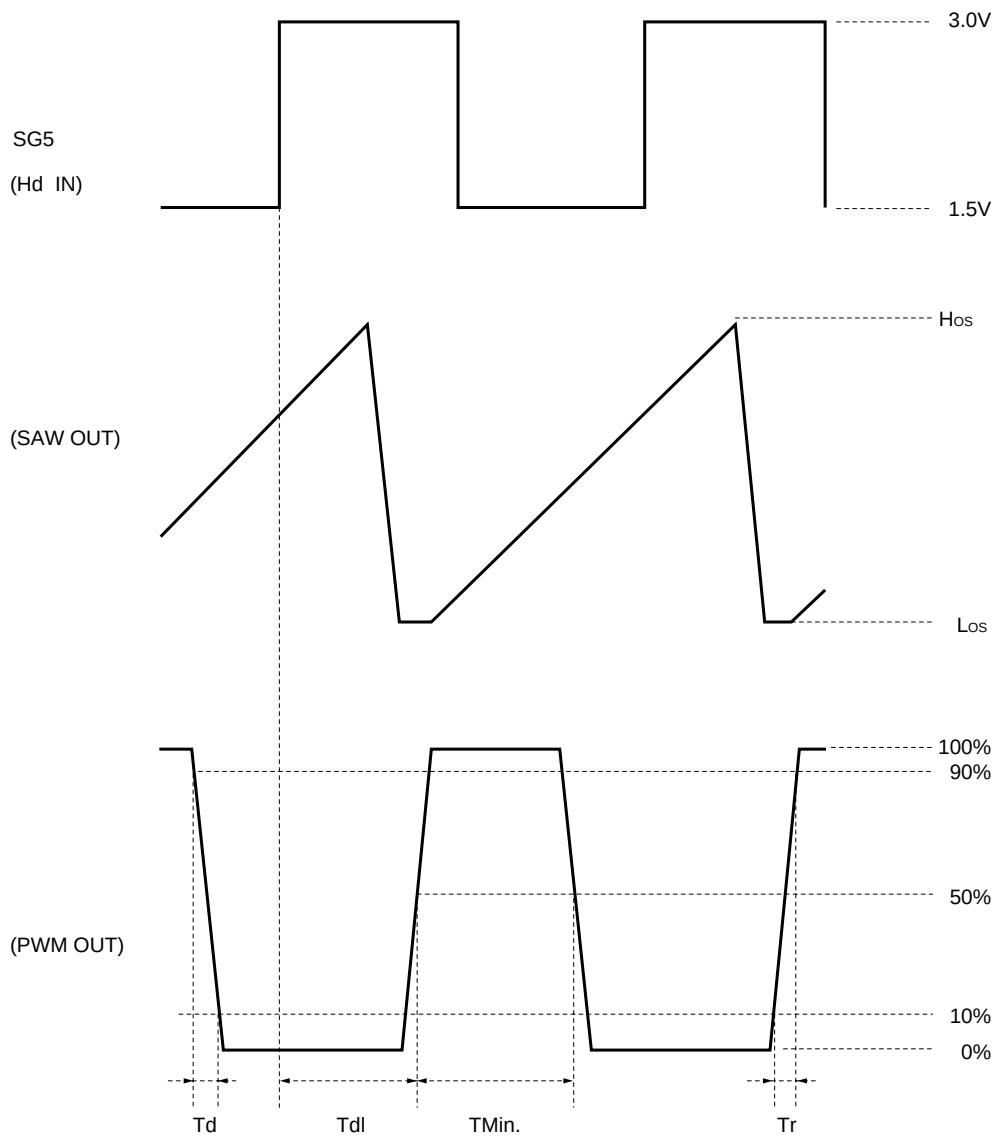
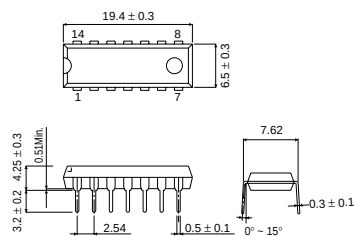


Fig.14

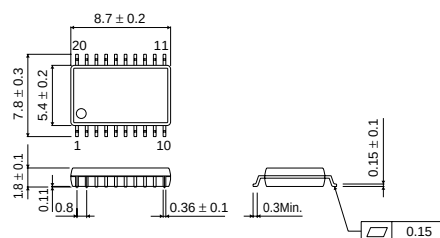
●External dimensions (Units: mm)

BA9756



DIP14

BA9756FS



SSOP-A20