High-voltage control circuit for CRT displays

BA9756FS

The BA9756FS is 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 ± 0.7%.

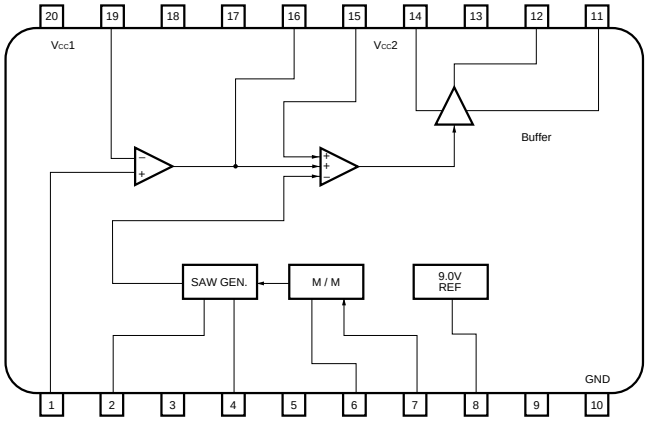
●Applications

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 ± 0.7%.

●Block diagram



●Absolute maximum ratings (Ta=25°C)

Parameter	Symbol	Limits	Unit
Power supply voltage 1	Vcc1	18	V
Power supply voltage 2	Vcc2	20	V
Power dissipation	Pd	750*1	mW
Operating temperature	Topr	- 25~+80	˚C
Storage temperature	Tstg	- 55~+125	˚C

*1 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)

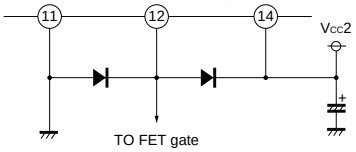
Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage 1	Vcc1	11	-	17	V
Power supply voltage 2	Vcc2	11	-	17	V

●Pin descriptions

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	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	MMCR (delay constant for monostable multivibrator)	A charging resistance of 4.7kΩ or higher should be used. The threshold level is 4.5V.
7	HDIN (Hd pulse input)	The threshold level is approximately 2.1V.
8	VREF9 (Ref 9V output)	An output deviation of ± 0.7% is assured through trimming.
9	N.C.	See*1.
10	GND (Signal GND)	This may be shared with the power GND, but make sure sufficiently stable grounding is provided.
11	GND (Power GND)	This may be shared with the signal GND, but make sure sufficiently stable grounding is provided.
12	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	$V_{CC}2$ (Power V_{CC})	A decoupling capacitor should be positioned in the vicinity of this pin.
15	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	ERROUT (error amplifier output)	This is the output pin for the error amplifier.
17	N.C.	See*1.
18	N.C.	See*1.
19	ERRREF (error amplifier input)	This is the input pin for the reference voltage.
20	$V_{CC}1$ (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**

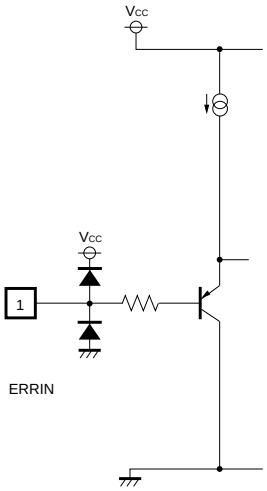


Fig.1

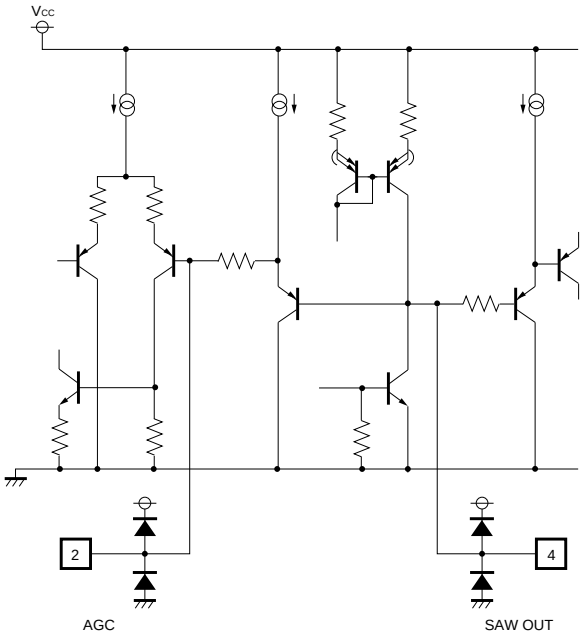


Fig.2

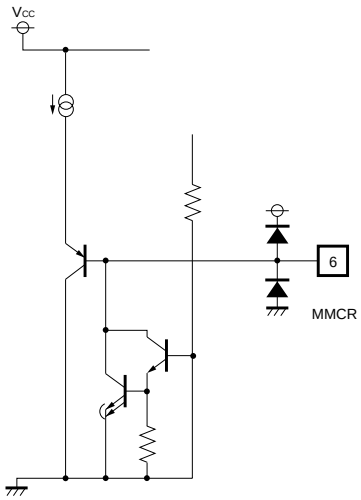


Fig.3

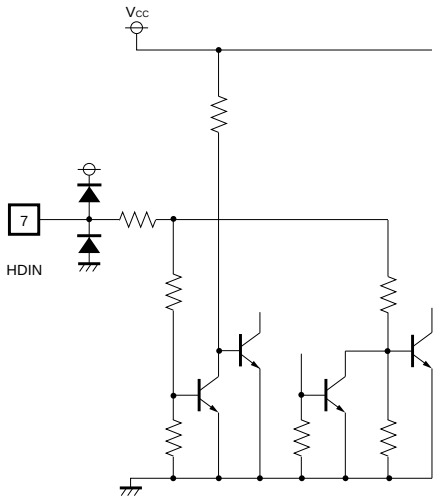


Fig.4

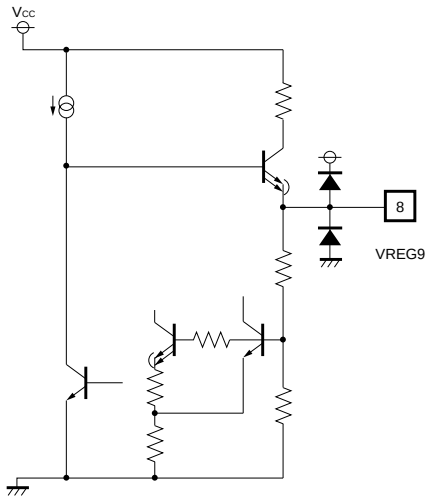


Fig.5

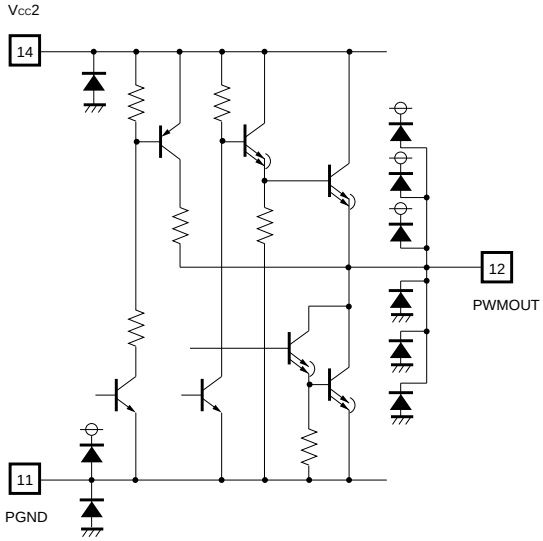


Fig.6

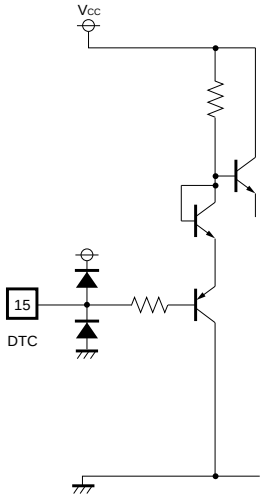


Fig.7

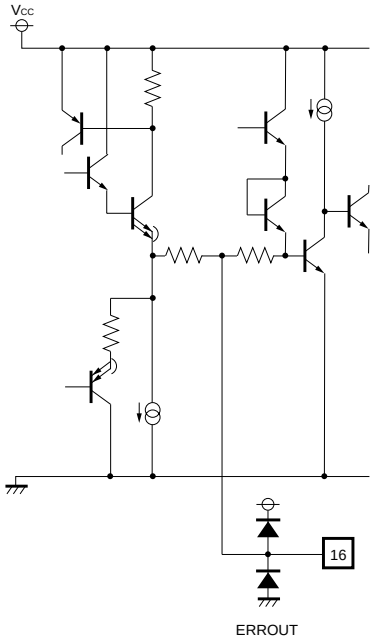


Fig.8

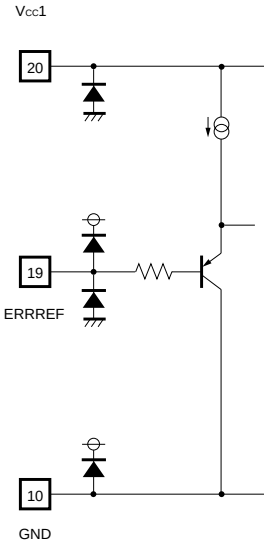


Fig.9

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

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Test Circuit
<Hd input pin>							
Input high level voltage	V_{IH}	3.0	-	V_{CC}	V	-	Fig.10
Input low level voltage	V_{IL}	-	-	1.5	V	-	Fig.10
Input high level current	I_{IH}	-	360	530	µA	V_{IN} = 15V	Fig.10
Input low level current	I_{IL}	-	0	-1	µA	-	Fig.10
<Monostable multivibrator>							
Delay time	T_{dl}	1.80	2.15	2.50	µs	R = 10kΩ,C = 220pF	Fig.10
<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	-	Fig.10
Output level f characteristic	f_{SAW}	150	200	-	kHz	-1dB drop from 30kHz	Fig.10
<Reference voltage supply>							
Output voltage	V_{REF9}	8.937	9.0	9.063	V	-	Fig.10
Max. output current	I_{rmax9}	10	-	-	mA	-	Fig.10
Output voltage thermal characteristics	T_{REF9}	-	± 0.1	± 0.3	%	Guaranteed design parameter at Ta = 25→0°C, 25→75°C	Fig.10
Thermal shutdown	T_{dow}	100	-	-	deg	Guaranteed design parameter	Fig.10

● **Measurement circuits**

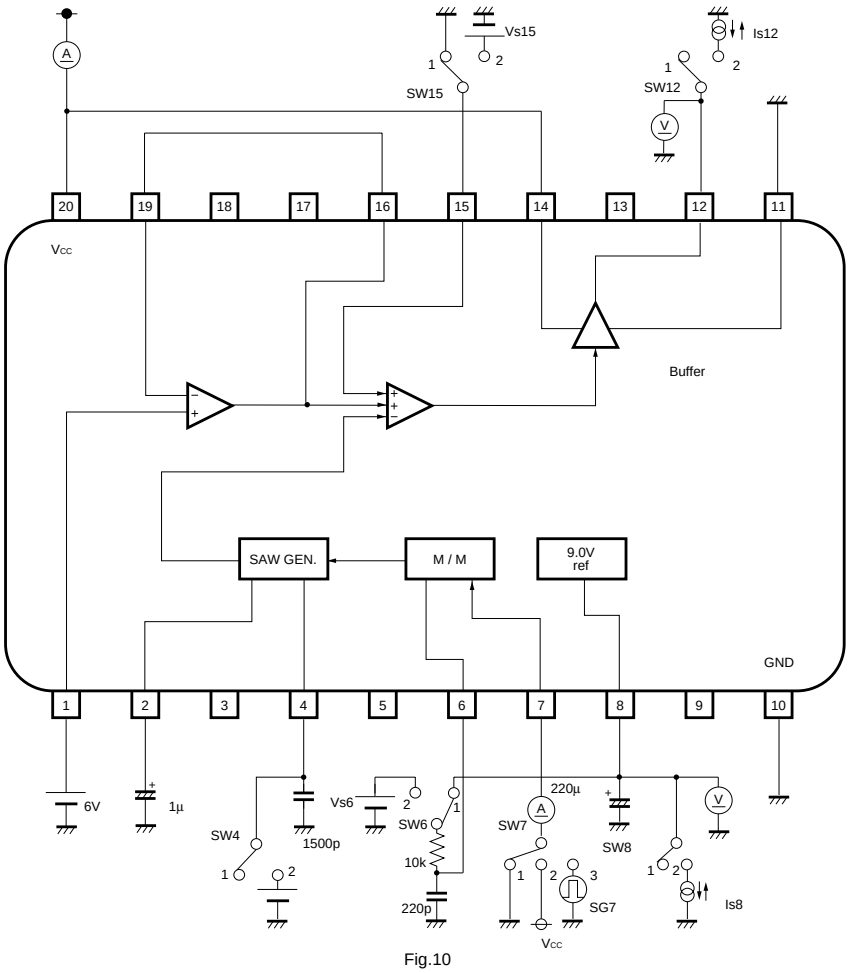


Fig.10

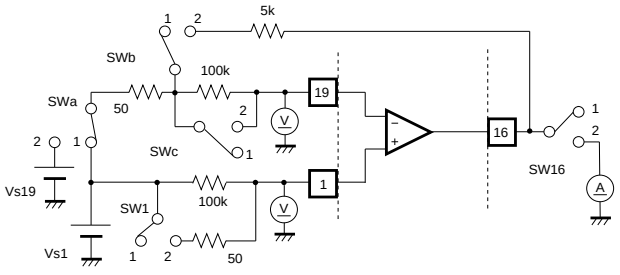


Fig.11

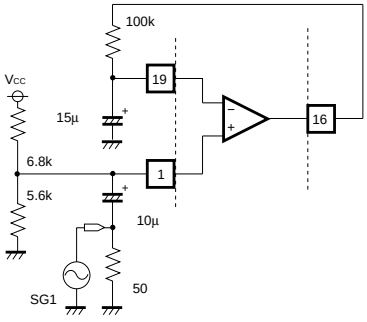


Fig.12

● **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	IB	1	1	1	1	1	1	1	1	1	1	1	Vs1 = 6V, IB = - $V_{IN} \times 10^{-5}$
Input offset voltage	V_{IO}	1	1	1	1	1	1	1	1	2	2	2	Vs1 = 6V, $V_{IO} = (V12 - 6) \times 10^{-2}$
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_{rmax9}	-	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

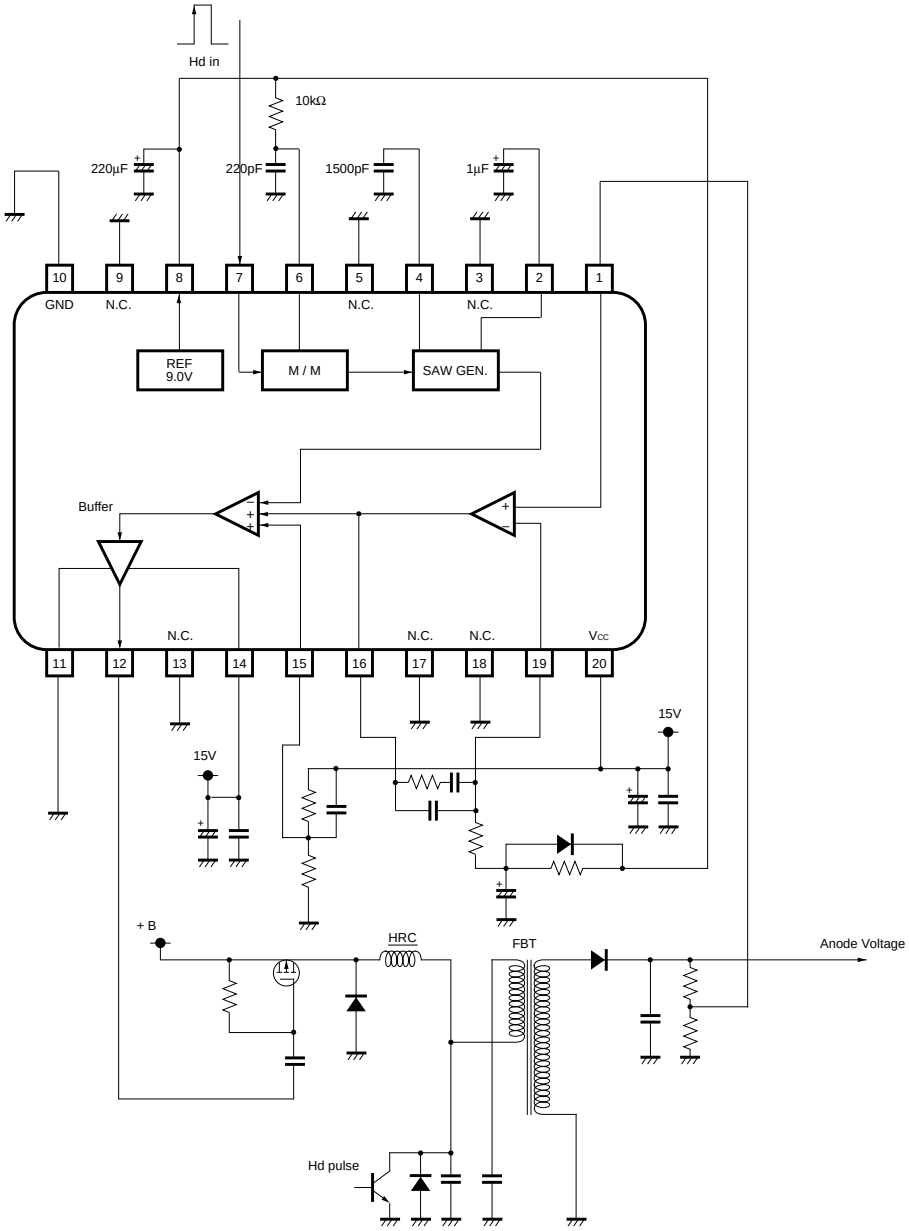
*1 The pin 12 output amplitude should be set to V_O. AV = 20log (V_O / V_{IN}) [dB]

*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**



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

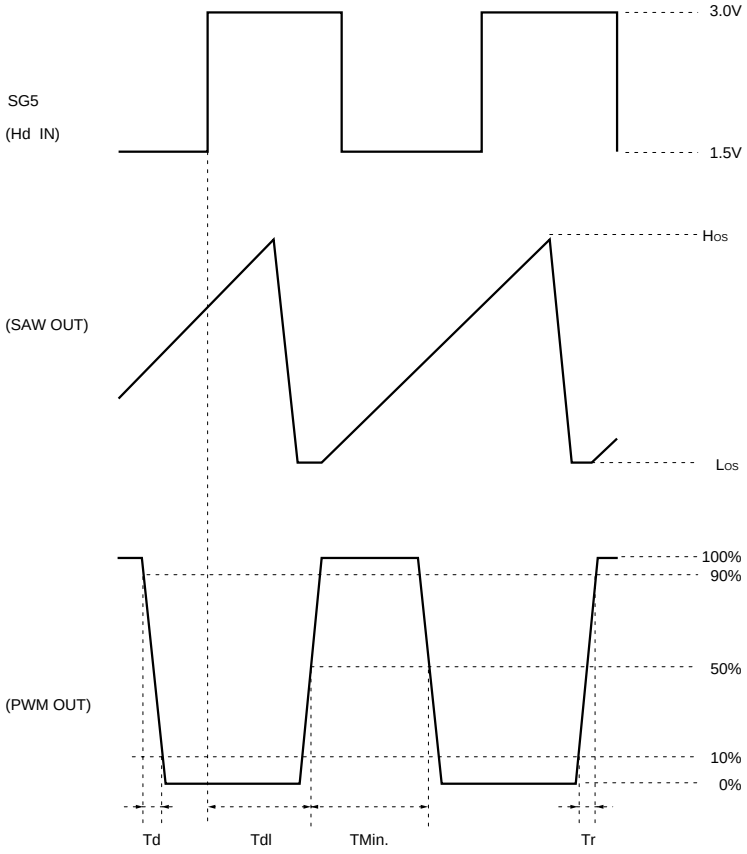
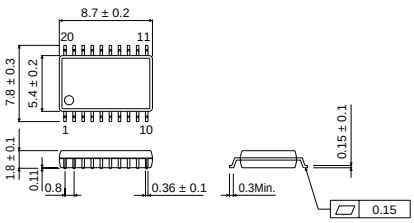


Fig.14

● **External dimensions** (Units: mm)

BA9756FS



SSOP-A20