

## OVERVIEW

The CF5746 Series devices are analog clock ICs that derive their timing from a 32 kHz oscillator element.

They feature alarm outputs, snooze function and alarm auto-stop function. They can be configured to match a wide variety of clock specifications, alarm functions and motor outputs.

## FEATURES

- 32.768 kHz oscillator circuit
  - $R_f$  and  $R_d$  built-in
  - Oscillator capacitance built-in
    - $C_D = 30$  pF (typ, excluding CF5746ADC)
    - $C_D = 20$  pF (typ, CF5746ADC)
- Alarm outputs
  - Compatible with electronic sound alarms and motor bells
  - 4-step increasing volume alarm output (CF5746AAB, ADC, AEA, AFA (AO1), AGA (AO1))
- Snooze function
  - Temporarily stops alarm output and then re-starts after a fixed time
- Debounce circuit (AI/SNZ pin)
- Test functions
  - Shortening snooze time and auto-stop time
  - Increasing motor speed (excluding CF5746BCA)
- Power-ON clear function
- 1.5 V supply voltage
- Chip form

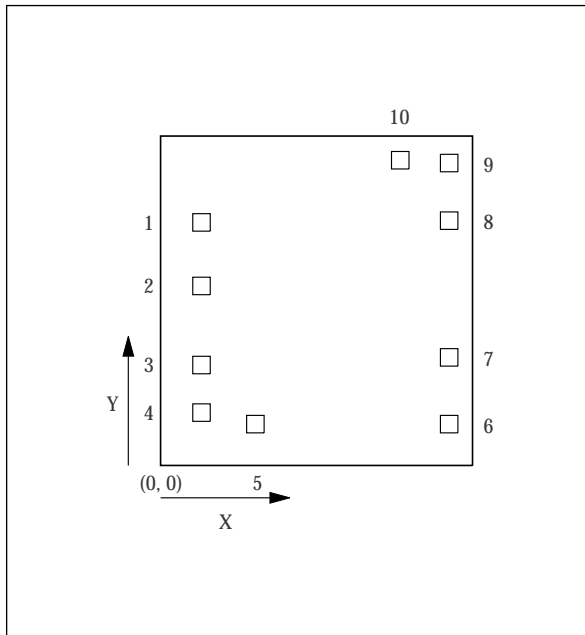
## SERIES CONFIGURATION

		CF5746AAB	CF5746ABA	CF5746BCA	CF5746ADC	CF5746AEA	CF5746AFA	CF5746AGA								
Built-in capacitance	XT pin $C_G$ (pF)	None	None	None	None	None	None	None								
	XT pin $C_G$ (pF)	30	30	30	20	30	30	30								
Motor output	Active level	HIGH	HIGH	-	HIGH	HIGH	HIGH	HIGH								
	Needle period $t_{cy}$ (s)	1	1	0.125	1	1	1	1								
	Pulsewidth $t_{pw}$ (ms)	23.4375	31.25	50% duty	46.875	31.25	46.875	31.25								
AI/SNZ input	Alarm active level	LOW	LOW	LOW	HIGH	LOW	LOW	LOW								
	Pin type	512 Hz	512 Hz	512 Hz	512 Hz	512 Hz	Pull-up	Pull-up								
	SNZ interface	Yes	Yes	Yes	No	Yes	Yes	Yes								
	SNZ time $t_{snz}$ (s)	256	256	256	256	256	256	256								
	Bounce delay (ms)	31.25	31.25	31.25	31.25	31.25	31.25	31.25								
	SNZ release	No	No	No	No	No	Yes (2 s)	Yes (2 s)								
	Pins	AO	$\overline{AO}$	AO1	AO2	AO1	AO2	AO	$\overline{AO}$	AO	$\overline{AO}$	AO1	AO2	AO1	AO2	
Alarm output	Active level	HIGH	LOW <sup>1</sup>	HIGH	HIGH	HIGH	HIGH	HIGH	LOW <sup>1</sup>	HIGH	LOW <sup>1</sup>	HIGH	HIGH	HIGH	HIGH	
	Frequency $f_{pw}$ (Hz)	4096	4096	DC	DC	DC	DC	2048	2048	2048	2048	2048	DC	2048	DC	
	Modulation $f_{cy}$ (Hz)	8+1	8+1	-	-	-	-	8+1	8+1	8+1	8+1	8+1	-	8+1	-	
	Duty (%)	Step 1	12.5	12.5	-	-	-	-	6.26	6.26	6.26	6.26	12.5	-	6.26	-
		Step 2	25	25	-	-	-	-	12.5	12.5	12.5	12.5	25	-	12.5	-
		Step 3	50	50	-	-	-	-	25	25	50	50	50	-	50	-
		Step 4	-	-	-	-	-	-	50	50	-	-	-	-	-	-
	Step time (s)	Step 1	0 to 7	0 to 7	-	-	-	-	0 to 3	0 to 3	0 to 7	0 to 7	0 to 7	-	0 to 7	-
		Step 2	7 to 15	7 to 15	-	-	-	-	3 to 7	3 to 7	7 to 15	7 to 15	7 to 15	-	7 to 15	-
		Step 3	15 to AS <sup>2</sup>	15 to AS	-	-	-	-	7 to 31	7 to 31	15 to AS	15 to AS	15 to AS	-	15 to AS	-
		Step 4	-	-	-	-	-	-	31 to AS	31 to AS	-	-	-	-	-	-
	$I_{OH}$ min (mA)	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	
$I_{OL}$ min (mA)	0.8	0.8	0.8	0.8	0.8	0.8	0.002	0.002	0.8	0.8	0.002	0.8	0.002	0.8		
Auto-stop $t_{STOP}$ (s)	128	128	128	128	128	128	128	128	128	128	128	128	128	128		
Pad layout	A		A		B		A		A		A		A			
Other	Power-ON clear, oscillator $R_d$ and $R_f$ built-in															

1.  $\overline{AO}$  has the opposite polarity to AO only when output (same phase when non-active).

2. AS = auto-stop

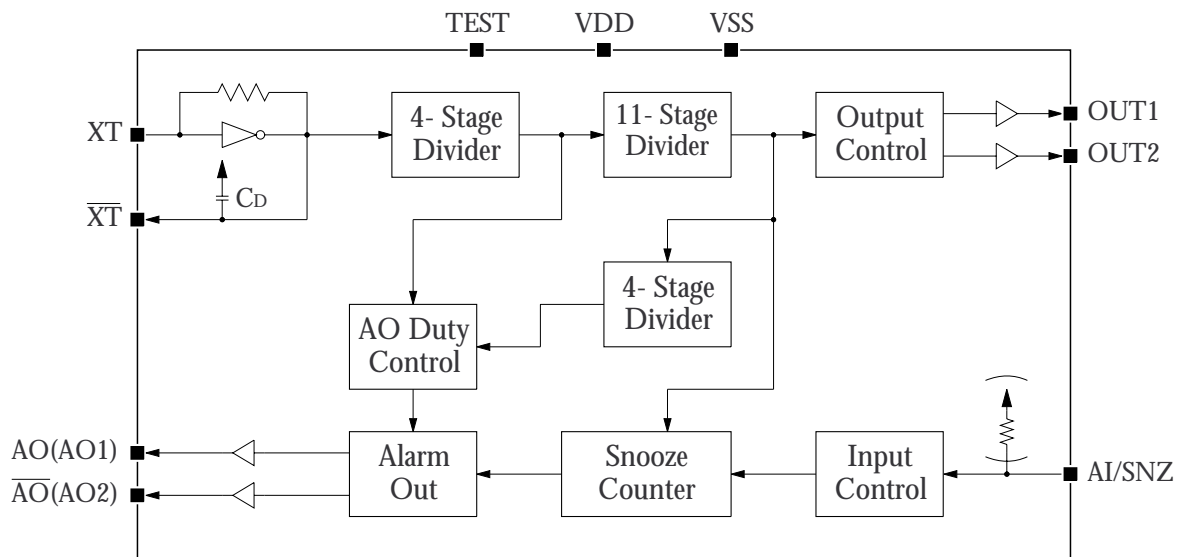
**PAD DIMENSIONS**



No.	Layout		Dimensions ( $\mu\text{m}$ )	
	A (ex. BCA)	B (BCA)	X	Y
1	VDD	VSS	166	1210
2	VSS	VDD	166	882
3	OUT1	AI/SNZ	166	474
4	AI/SNZ	AO1	166	228
5	TEST	AO2	444	169
6	OUT2	OUT1	1444	169
7	AO (AO1)	OUT2	1444	513
8	$\overline{\text{AO}}$ (AO2)	TEST	1444	1219
9	$\overline{\text{XT}}$	$\overline{\text{XT}}$	1444	1516
10	XT	XT	1192	1531

Chip size:  $1.61 \times 1.70$  mm  
 Chip thickness:  $400 \pm 30$   $\mu\text{m}$   
 Pad size:  $100 \times 100$   $\mu\text{m}$   
 Chip surface is at  $V_{DD}$  potential.

**BLOCK DIAGRAM**



## PIN DESCRIPTION

Name	Description
VDD	Positive supply voltage pin
VSS	Ground pin
XT	Oscillator input pin
$\overline{\text{XT}}$	Oscillator output pin
OUT1	Motor output pin 1
OUT2	Motor output pin 2
AI/SNZ	Alarm/snooze input pin
AO (AO1)	Alarm output pin
$\overline{\text{AO}}$ (AO2)	Alarm output pin
TEST	Test pin

## SPECIFICATIONS

### Absolute Maximum Ratings

Parameter	Symbol	Condition	Rating	Unit
Supply voltage range	$V_{\text{DD}} - V_{\text{SS}}$		-0.3 to 5.0	V
Input voltage range	$V_{\text{IN}}$		$V_{\text{SS}}$ to $V_{\text{DD}}$	V
Operating temperature range	$T_{\text{opr}}$		-30 to 70	°C
Storage temperature range	$T_{\text{stg}}$		-40 to 125	°C

### Electrical Characteristics

$T_a = 25\text{ °C}$ ,  $V_{\text{DD}} = 1.5\text{ V}$ ,  $V_{\text{SS}} = 0\text{ V}$ ,  $f_0 = 32.768\text{ kHz}$  unless otherwise noted

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Operating voltage	$V_{\text{DD}}$	No load	1.2	-	2.0	V
Current consumption <sup>1</sup>	$I_{\text{DD}}$		-	1.0	2.0	μA
Motor output current	$I_{\text{MOT}}$	$V_{\text{DD}} = 1.2\text{ V}$ , $R_L = 200\ \Omega$	±3.8	-	-	mA
Alarm HIGH-level output current	$I_{\text{OH}}$	$V_{\text{DD}} = 1.2\text{ V}$ , $V_{\text{OH}} = 0.7\text{ V}$	-0.8	-1.5	-	mA
Alarm LOW-level output current <sup>2</sup>	$I_{\text{OL}}$	$V_{\text{DD}} = 1.2\text{ V}$ , $V_{\text{OL}} = 0.5\text{ V}$	0.8	1.5	-	mA
Alarm LOW-level output current <sup>3</sup>			2	15	30	μA
AI/SNZ HIGH-level input voltage	$V_{\text{IH}}$		$V_{\text{DD}} - 0.2$	-	$V_{\text{DD}}$	V
AI/SNZ LOW-level input voltage	$V_{\text{IL}}$		$V_{\text{SS}}$	-	$V_{\text{SS}} + 0.2$	V
AI/SNZ HIGH-level output current	$I_{\text{OH}}$	$V_{\text{OH}} = V_{\text{DD}} - 1.5\text{ V}$	-1	-3	-10	μA
AI/SNZ LOW-level output current	$I_{\text{OL}}$	$V_{\text{OL}} = V_{\text{DD}} + 1.5\text{ V}$				
Oscillator frequency stability	$\Delta f/f$	$V_{\text{DD}} = 1.2\text{ to }2.0\text{ V}$	-	0.5	1	ppm/0.1 V
VDD-to-XT pin built-in capacitance	$C_G$		-	None	-	pF
VDD-to- $\overline{\text{XT}}$ pin built-in capacitance	$C_D$	Excluding CF5746ADC	-	30	-	pF
		CF5746ADC	-	20	-	pF

1. All pins except the supply and crystal oscillator pins are open.

2. CF5746AAB, ABA, BCA, AEA, AFA (AO2), AGA (AO2)

3. CF5746ADC, AFA (AO1), AGA (AO2)

## FUNCTIONAL DESCRIPTION

### Alarm Input/Output

#### AI/SNZ input Debouncing circuit

A bounce delay is provided on the AI/SNZ input, regardless of whether the input is LOW or HIGH, to eliminate erroneous operation caused by input bounce. For  $t_{ON} \leq 31.25$  ms, any alarm input or snooze input signal is ignored. For  $t_{ON} \geq 62.5$  ms, the alarm input or snooze input is accepted.

#### Alarm/snooze function

An active level on AI/SNZ for  $\geq 62.5$  ms triggers the alarm function, and alarm operation starts.

During alarm output, an active level on AI/SNZ for  $\geq 62.5$  ms triggers the snooze function. In snooze mode, the alarm output is temporarily stopped for an interval of approximately 256 seconds. After this interval ends, alarm output restarts.

For devices other than the CF5746ADC, the snooze interval count is restarted from 0 if another snooze input is received while in snooze mode. After the snooze interval ends, alarm output restarts.

For the CF5746AFA and AGA, an active level on AI/SNZ for  $\geq 2$  s in snooze mode cancels the snooze and immediately the alarm signal restarts (snooze release).

	CF5746AAB	CF5746ABA	CF5746BCA	CF5746ADC	CF5746AEA	CF5746AFA	CF5746AGA
Alarm active level	LOW	LOW	LOW	HIGH	LOW	LOW	LOW
SNZ interface	Yes	Yes	Yes	No	Yes	Yes	Yes
SNZ time $t_{snz}(s)$	256	256	256	256	256	256	256
SNZ release	No	No	No	No	No	Yes (2 s)	Yes (2 s)

#### Alarm output

The CF5746 Series devices feature a combination of various alarm output options to cover a wide range of clock specifications.

- Step output function (CF5746AAB, ADC, AEA, AFA (AO1), AGA (AO1))

The alarm output increases in volume over 3 or 4 steps, depending on the device selected.

- Auto-stop function

After the alarm has been active continuously for 128 seconds, auto-stop mode becomes active and the output stops.

	CF5746AAB		CF5746ABA		CF5746BCA		CF5746ADC		CF5746AEA		CF5746AFA		CF5746AGA		
Pins	AO	$\overline{AO}$	AO1	AO2	AO1	AO2	AO	$\overline{AO}$	AO	$\overline{AO}$	AO1	AO2	AO1	AO2	
Active level	HIGH	LOW <sup>1</sup>	HIGH	HIGH	HIGH	HIGH	HIGH	LOW <sup>1</sup>	HIGH	LOW <sup>1</sup>	HIGH	HIGH	HIGH	HIGH	
Frequency $f_{pw}$ (Hz)	4096	4096	DC	DC	DC	DC	2048	2048	2048	2048	2048	DC	2048	DC	
Modulation fcy (Hz)	8+1	8+1	–	–	–	–	8+1	8+1	8+1	8+1	8+1	–	8+1	–	
Duty (%)	Step 1	12.5	12.5	–	–	–	–	6.26	6.26	6.26	6.26	12.5	–	6.26	–
	Step 2	25	25	–	–	–	–	12.5	12.5	12.5	12.5	25	–	12.5	–
	Step 3	50	50	–	–	–	–	25	25	50	50	50	–	50	–
	Step 4	–	–	–	–	–	–	50	50	–	–	–	–	–	–
Step time (s)	Step 1	0 to 7	0 to 7	–	–	–	–	0 to 3	0 to 3	0 to 7	0 to 7	0 to 7	–	0 to 7	–
	Step 2	7 to 15	7 to 15	–	–	–	–	3 to 7	3 to 7	7 to 15	7 to 15	7 to 15	–	7 to 15	–
	Step 3	15 to AS <sup>2</sup>	15 to AS	–	–	–	–	7 to 31	7 to 31	15 to AS	15 to AS	15 to AS	–	15 to AS	–
	Step 4	–	–	–	–	–	–	31 to AS	31 to AS	–	–	–	–	–	–
Auto-stop $t_{stop}(s)$	128		128		128		128		128		128		128		

1.  $\overline{AO}$  has the opposite polarity to AO only when output (same phase when non-active).

2. AS = auto-stop

## Motor Output

The motor output can be matched to the clock using a step needle movement (3 options) or a continuous needle movement (1 option), depending on the device selected.

	CF5746AAB	CF5746ABA	CF5746BCA	CF5746ADC	CF5746AEA	CF5746AFA	CF5746AGA
Active level	HIGH	HIGH	-	HIGH	HIGH	HIGH	HIGH
Needle period $t_{cy}$ (s)	1	1	0.125	1	1	1	1
Pulsewidth $t_{pw}$ (ms)	23.4375	31.25	50% duty	46.875	31.25	46.875	31.25
Movement	Step	Step	Continuous	Step	Step	Step	Step

## Test Functions

### Open-circuit output

When AI/SNZ is open circuit, a 512 Hz tone is output (except on the CF5746AFA and AGA).

### Time shortening function

This function is used to reduce the alarm output snooze interval and the auto-stop time. This function is active under either of the following conditions.

- TEST must be HIGH.
- OUT1 and OUT2 must both be HIGH.

Note that devices other than the CF5746BCA (that is, the step needle movement devices) also have reduced motor output needle periods for the case where TEST is HIGH.

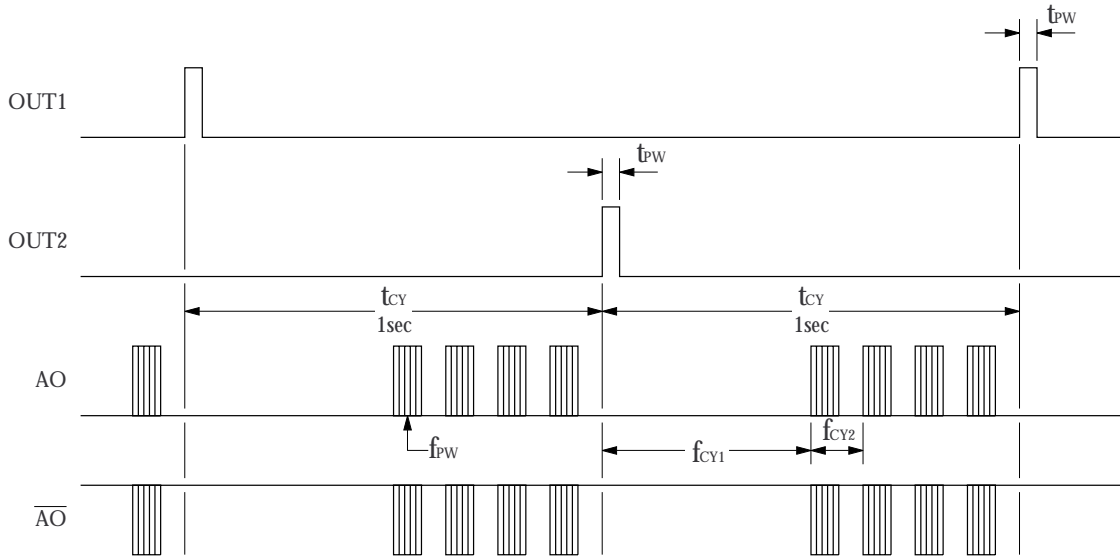
	TEST = HIGH			OUT1 = OUT2 = HIGH		
Motor output needle period	1/4	1/4	-	-	-	-
Alarm output	Unmodulated	-	-	Unmodulated	-	-
Auto-stop time	1/1024	1/1024	1/1024	1/1024	1/1024	1/1024
Snooze interval	1/1024	1/1024	1/1024	1/1024	1/1024	1/1024
Device	AAB ADC AEA AFA (AO1) AGA (AO1)	ABA AFA (AO2) AGA (AO2)	BCA	AAB ADC AEA AFA (AO1) AGA (AO1)	ABA AFA (AO2) AGA (AO2)	BCA

### Power-ON Clear Function

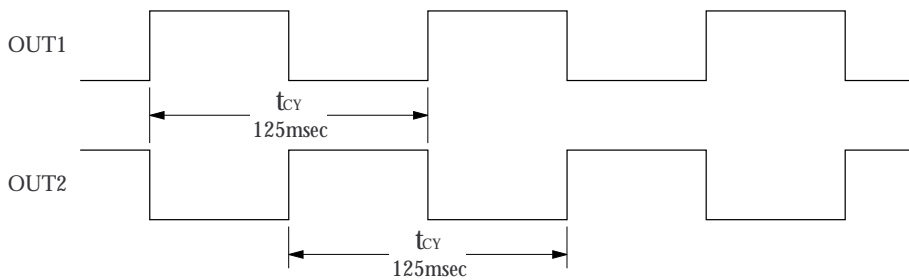
When power is first applied, the snooze state and alarm auto-stop state are reset to their default values.

**TIMING DIAGRAMS**

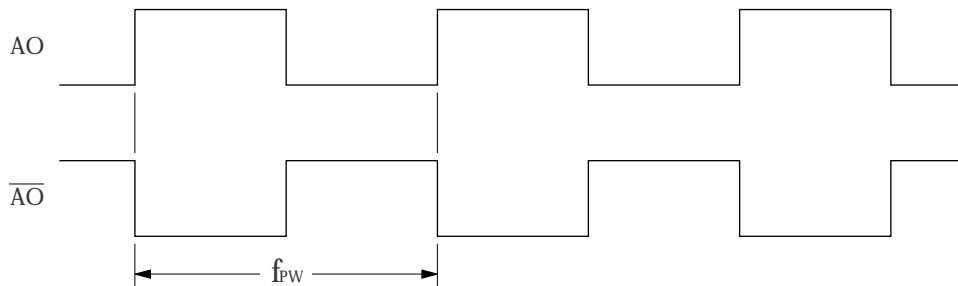
**Motor Output (Step Movement): excluding CF5746BCA**  
**Alarm Output: CF5746AAB, ADC, AEA, AFA (AO1), AGA (AO1)**



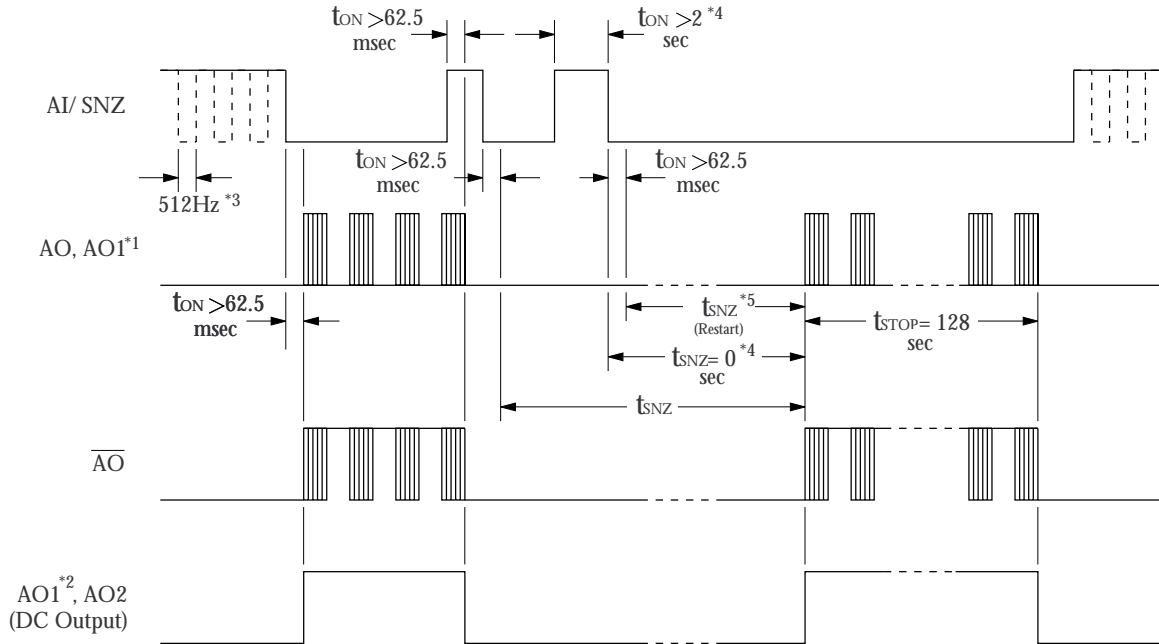
**Motor Output (Continuous Movement): CF5746BCA**



**Alarm Step Output: CF5746AAB, ADC, AEA, AFA (AO1), AGA (AO1)**

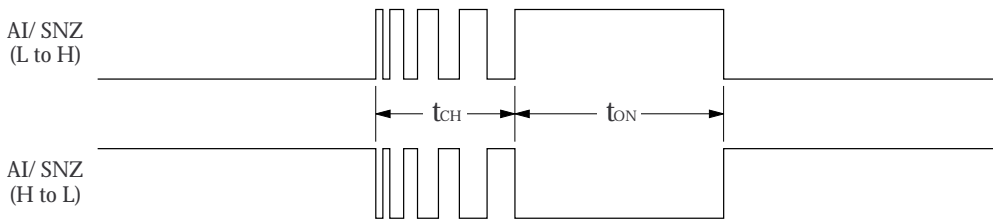


**Alarm/Snooze Input and Alarm Output**




- \*1: CF5746AFA, AGA
- \*2: CF5746ABA, BCA
- \*3: CF5746AAB, ABA, BCA, ADC, AEA
- \*4: CF5746AFA, AGA
- \*5: CF5746AAB, ABA, BCA, AEA, AFA, AGA

**Alarm/Snooze Input (Debouncing Circuit)**



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