

HT93111/HT93112/HT93121/HT93122 Low Power Comparator

Features

- Wide Supply Voltage Range: 1.4V to 5.5V
- Low Quiescent Current
- Propagation Delay: 5.5µs (Max.)
- Rail to Rail input and output operation
- Internal Hysteresis: 20mV (Max.)
- Operating Temperature Range: -40°C to +85°C
- Available in Single and Dual versions
- Package types:
 - HT93111/HT93121: 5-pin SOT23, 8-pin SOP
 - HT93112/HT93122: 8-pin SOP

Applications

- Battery Level Detectors
- Alarm and Monitoring Circuits
- Logic Level Shifting or Translation
- Window Comparators
- Threshold Detectors
- RC Timers
- Multi-vibrators
- Mobile Communications and Notebooks
- RF/IR Receivers

General Description

The HT93111/HT93121/HT93112/HT93122 family of low power comparators offers the benefits of low power consumption, low offset voltage and low offset drift. The HT93111/HT93121 are offered in single channel and the HT93112/HT93122 are offered in dual channel. They have low propagation delay and have good PSRR and CMRR characteristics. These devices also provide full rail-to-rail input and output operation.

The devices operate with a single supply voltage as low as 1.4V and with a low supply current of 0.8μ A/comparator (Typ.).

The HT93111/HT93112 family of comparators has push-pull output and supports rail-to-rail output swing and interfaces with TTL/CMOS logic. However, the HT93121/HT93122 family of comparators has open-drain output and can be used as a level-shifter for up to 6V using a pull-up resistor.

With their single wide range of supply voltage and low power consumption features coupled with their low offset voltage, these comparators are suitable for use in a wide range of applications. Besides, small-sized packages provide options for portable and space-restricted applications.

Part No.	Output Type	Operating Voltage	Channel Number	Latch Enable	Package	Marking
HT93111A					SOT23-5	3111A
HT93111B	Duch Dull	1.4V~5.5V 1	1	~	SOT23-5	3111B
HT93111C	FusitFull		Ŷ	SOT23-5	3111C	
HT93111					8SOP	HT93111
HT93121A				v	SOT23-5	3121A
HT93121B	Open Drain	1 / 1 = 5 = 5 / 1	1		SOT23-5	3121B
HT93121C	Open Drain	1.40~5.50	I	T	SOT23-5	3121C
HT93121					8SOP	HT93121
HT93112*	Push Pull	1.4V~5.5V	2	N	8SOP	HT93112
HT93122*	Open Drain	1.4V~5.5V	2	N	8SOP	HT93122

Selection Table

Note: * Under development



Block Diagram

HT93111/HT93121



HT93112/HT93122





Pin Assignment



Pin Description

HT93111/HT93121

Pin Name	Туре	Description
OUT	AO	Push-Pull Output for HT93111; Open-Drain Output for HT93121
IN+	AI	Non-inverting Input
IN-	AI	Inverting Input
VDD	PWR	Positive Power Supply
VSS	PWR	Negative Power Supply

Legend: AI: Analog Input; AO: Analog Output; I: Input; PWR: Power.



HT93112/HT93122

Pin Name	Туре	Description
AOUT	AO	Push-Pull Output for HT93112 CMP-A; Open-Drain Output for HT93122 CMP-A
AIN+	AI	Non-inverting Input for CMP-A
AIN-	AI	Inverting Input for CMP-A
BOUT	AO	Push-Pull Output for HT93112 CMP-B; Open-Drain Output for HT93122 CMP-B
BIN+	AI	Non-inverting Input for CMP-B
BIN-	AI	Inverting Input for CMP-B
VDD	PWR	Positive Power Supply
VSS	PWR	Negative Power Supply

Legend: AI: Analog Input; AO: Analog Output; PWR: Power.

Absolute Maximum Ratings

Supply Voltage Vss-0.3V to 6.0V	I _{OH} Total80mA
Input Voltage V_{cc-0} 3V to V _{pp+0} 3V	IoL Total
Storage Temperature	Total Power Dissipation 500mW
Operating Temperature40°C to 85°C	

Note: These are stress ratings only. Stresses exceeding the range specified under "Absolute Maximum Ratings" may cause substantial damage to these devices. Functional operation of these devices at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

Electrical Characteristics

HT93111/HT93112

Symbol	Parameter	Test Conditions	Min.	Тур.	Max.	Unit	
Input Cha	Input Characteristics						
Vos	Input Offset Voltage	V _{CM} =V _{SS}	-12	_	12	mV	
$\Delta V_{OS} / \Delta T_A$	Input Offset Voltage Drift with Temperature	V _{см} =V _{ss} , Ta=-40°C~85°С	_	±2	_	µV/°C	
I _B	Input Bias Current	V _{CM} =V _{SS}	—	38	—	pА	
los	Input Offset Current	V _{CM} =V _{SS}	_	1	—	pА	
V _{CMR}	Common Mode Input Voltage Range	—	V _{ss} -0.3	_	V _{DD} +0.3	V	
V _{HYST}	Input Hysteresis Voltage	V _{CM} =V _{SS} ⁽¹⁾	-20	_	20	mV	
Vih	Latch Enable Pin High Input Voltage	HT93111 only	Vss	_	$0.2V_{DD}$	V	
VIL	Latch Enable Pin Low Input Voltage	HT93111 only	0.8V _{DD}	_	Vdd	V	
		V _{DD} =5V, V _{CM} =-0.3V to 5.3V	67	85	—		
CMRR	Common Mode Rejection	V_{DD} =5V, V_{CM} =2.5V to 5.3V	65	80	—	dB	
		V _{DD} =5V, V _{CM} =-0.3V to 2.5V	65	85	—		
PSRR	Power Supply Rejection	V _{CM} =V _{SS}	75	90	_	dB	
Aol	DC Open-Loop Gain (Large Signal)	R _L =50kΩ to V _L , V _{OUT} =0.1V to V _{DD} -0.1V	_	105	_	dB	

Unless otherwise indicated,	V _{DD} =1.4V~5.5V,	Vss=GND, Ta=25	°C, V _{IN+} =V _{DD} /2, V	VIN-=VSS, VL=VDD/	2, $R_L=1M\Omega$ to V_L .
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Symbol	Parameter	Test Conditions	Min.	Тур.	Max.	Unit	
Output Cl	haracteristics						
tрнL	Descention Delay (Hink to Law)	V _{DD} =1.4V to 1.6V, V _{IN+} =V _{DD} /2, Overdrive=100mV, C _L =30pF, Ta=-40°C~85°C		1.4	1.6		
	Fropagation Delay (Figh-to-Low)	V _{DD} =1.6V to 5.5V, V _{IN+} =V _{DD} /2, Overdrive=100mV, C _L =30pF, Ta=-40°C~85°C		1.4	1.6	μs	
	Dermonation Delay (Louida Hink)	V _{DD} =1.4V to 1.6V, V _{IN+} =V _{DD} /2, Overdrive=100mV, C _L =30pF, Ta=-40°C~85°C		2.3	2.4		
t _{PLH} Propagation Delay	Propagation Delay (Low-to-Hign)	V _{DD} =1.6V to 5.5V, V _{IN+} =V _{DD} /2, Overdrive=100mV, C _L =30pF, Ta=-40°C~85°C		4.2	5.5	μs	
t _{PDS}	Propagation Delay Skew	V_{DD} =1.4V to 5.5V, V_{IN+} = $V_{DD}/2$, Overdrive=100mV, CL=30pF ⁽²⁾	_	±1	_	μs	
t _R	Rise Time	$V_{IN+}=V_{DD}/2$, Overdrive=100mV, $C_L=30pF$	_	5	_	ns	
t⊧	Fall Time	$V_{IN+}=V_{DD}/2$, Overdrive=100mV, $C_L=30pF$	_	5	_	ns	
t _{LPD}	Latch Propagation Delay	HT93111 only	_	20	_	ns	
Vol	Minimum Output Voltage Swing	R_L =50k Ω to V _L , 0.5V input overdrive	_	_	V _{ss} +10	m)/	
V _{он}	Maximum Output Voltage Swing	R_L =50k Ω to V _L , 0.5V input overdrive	V _{DD} -10	_	_	mv	
	Output Short Circuit Current	V _{DD} =1.4V	_	±2	_	mA	
Isc		V _{DD} =5.5V	_	±30	_	mA	
Power Su	Power Supply						
VDD	Supply Voltage	—	1.4	_	5.5	V	
	Quiescent Current per Comparator	OUT=High, Ta=25°C	—	0.8	1.3	μA	
		OUT=Low, Ta=25°C	—	1.3	2.0	μA	
Temperat	ure				·		
Та	Operating Temperature Range	—	-40		85	°C	

Note: 1. The input offset voltage is the average of the input-referred trip points. The input hysteresis is the difference between the input-referred trip points.

2. Propagation Delay Skew is defined as: $t_{PDS}=t_{PLH}-t_{PHL}$.

HT93121/HT93122

Unless otherwise indicated, V_{DD} =1.4V~5.5V, V_{SS} =GND, Ta=25°C, V_{IN+} = $V_{DD}/2$, V_{IN-} = V_{SS} , R_{PU} =2.74k Ω to V_{PU} = V_{DD} .

Symbol	Parameter	Test Conditions	Min.	Тур.	Max.	Unit	
Input Cha	Input Characteristics						
Vos	Input Offset Voltage	V _{CM} =V _{SS}	-12	_	12	mV	
$\Delta V_{OS} / \Delta T_A$	Input Offset Voltage Drift with Temperature	V _{см} =V _{ss} , Ta=-40°C~85°С	_	±2	_	µV/°C	
IB	Input Bias Current	V _{CM} =V _{SS}	_	38	—	pА	
los	Input Offset Current	V _{CM} =V _{SS}	_	1	—	pА	
V _{CMR}	Common Mode Input Voltage Range	_	Vss-0.3	_	V _{DD} +0.3	V	
V _{HYST}	Input Hysteresis Voltage	$V_{CM}=V_{SS}$ (1)	-20	_	20	mV	
Vih	Latch Enable Pin High Input Voltage	HT93121 only	Vss	_	$0.2V_{DD}$	V	
VIL	Latch Enable Pin Low Input Voltage	HT93121 only	0.8V _{DD}	_	V _{DD}	V	



HT93111/HT93112/HT93121/HT93122

Symbol	Parameter	Test Conditions	Min.	Тур.	Max.	Unit	
		V_{DD} =5V, V_{CM} =-0.3V to 5.3V	67	85	_		
CMRR	Common Mode Rejection	V _{DD} =5V, V _{CM} =2.5V to 5.3V	65	80	_	dB	
		V _{DD} =5V, V _{CM} =-0.3V to 2.5V	65	85	_		
PSRR	Power Supply Rejection	V _{CM} =V _{SS}	75	90	—	dB	
Aol	DC Open-Loop Gain (Large Signal)	$\begin{array}{l} R_{\text{PU}} = 2.74 k\Omega \text{ to } V_{\text{PU}}, \\ V_{\text{OUT}} = 0.1 V \text{ to } V_{\text{DD}} = 0.1 V \end{array}$	_	105	_	dB	
Output Cl	naracteristics						
	Dependention Delay (Lighta Law)	V _{DD} =1.4V to 1.6V, V _{IN+} =V _{DD} /2, Overdrive=100mV, C _L =30pF, Ta=-40°C~85°C	_	1.4	1.6		
L'PHL	Propagation Delay (High-to-Low)	V _{DD} =1.6V to 5.5V, V _{IN+} =V _{DD} /2, Overdrive=100mV, C _L =30pF, Ta=-40°C~85°C	_	1.4	1.6	μs	
	Propagation Delay (Low-to-High)	V _{DD} =1.4V to 1.6V, V _{IN+} =V _{DD} /2, Overdrive=100mV, C _L =30pF, Ta=-40°C~85°C	_	2.3	2.4	μs	
TPLH		V _{DD} =1.6V to 5.5V, V _{IN+} =V _{DD} /2, Overdrive=100mV, C _L =30pF, Ta=-40°C~85°C	_	4.2	5.5		
t _{PDS}	Propagation Delay Skew	$V_{\text{DD}}\text{=}1.4\text{V}$ to 5.5V, $V_{\text{IN+}}\text{=}V_{\text{DD}}/2,$ Overdrive=100mV, $C_{\text{L}}\text{=}30\text{pF}^{\ (2)}$	_	±1	_	μs	
t⊨	Fall Time	$V_{IN+}=V_{DD}/2$, Overdrive=100mV, $C_L=30pF$		5	_	ns	
t _{LPD}	Latch Propagation Delay	HT93121 only		20	—	ns	
V _{OL}	Minimum Output Voltage Swing	$R_{PU}=2.74k\Omega$ to V_{PU} , 0.5V input overdrive	—	_	V _{ss} +10	mV	
1	Output Short Circuit Current	V _{DD} =1.4V		2	—	mA	
ISC		V _{DD} =5.5V	—	30	_	mA	
Power Su	pply						
Vdd	Supply Voltage	—	1.4		5.5	V	
	Quiescent Current per Comparator	OUT=High, Ta=25°C		0.8	1.3	μA	
	Quescent Current per Comparator	OUT=Low, Ta=25°C		1.3	2.0	μA	
Temperat	ure						
Та	Operating Temperature Range	_	-40		85	°C	

Note: 1. The input offset voltage is the average of the input-referred trip points. The input hysteresis is the difference between the input-referred trip points.

2. Propagation Delay Skew is defined as: $t_{PDS}=t_{PLH}-t_{PHL}$.



Special Function Description

Internal Hysteresis

The HT93111/HT93121/HT93112/HT93122 family has an internally-set hysteresis which has two trip points, one for the rising input voltage and the other for the falling input voltage. The internally-set hysteresis is large enough to eliminate output glitch caused by the comparator's own input noise voltage. The Figure 2 and Figure 3 show this behavior.



Figure 2. Internal Hysteresis with Non-Inverting Output



Figure 3. Internal Hysteresis with Inverting Output

External Hysteresis

More flexible hysteresis is achieved by using external resistors. Hysteresis reduces output chattering when one input is slowly going past the other input and thus reduces dynamic supply current. It also helps in systems where it is best not to switch between states too frequently, e.g., air conditioner thermostatic control.

Non-Inverting Circuit with External Hysteresis

Figure 4 shows a non-inverting circuit with external hysteresis using just two resistors. The resulting external hysteresis diagram for the non-inverting circuit is shown in Figure 5. The trip points for the non-inverting circuit with external hysteresis are:



Figure 5. External Hysteresis Diagram for Non-Inverting Circuit



Inverting Circuit with External Hysteresis

Figure 6 shows an inverting circuit with external hysteresis using just three resistors. In order to simplify the circuit, the Thevenin equivalent circuit of Figure 6 is shown in Figure 7. The resulting external hysteresis diagram for the inverting circuit is shown in Figure 8. The trip points for the inverting circuit with external hysteresis are:

$$V_{TH} = \frac{R_T}{R_T + R_3} V_{OH} + \frac{R_3}{R_T + R_3} V_T$$
$$V_{TL} = \frac{R_T}{R_T + R_3} V_{OL} + \frac{R_3}{R_T + R_3} V_T$$

Where

$$R_{T} = \frac{R_{1}R_{2}}{R_{1}+R_{2}}$$
$$V_{T} = \frac{R_{2}}{R_{1}+R_{2}} V_{DD}$$

$$V_{DD}$$

 R_1
 R_2
 V_{IN}
 V_{SS}
 V_{DD}
 V_{OUT}









Figure 8. External Hysteresis Diagram for Inverting Circuit



Application Circuits

HT93111/HT93121





HT93112/HT93122



HT93112 Window Comparator



HT93122 Window Comparator



Package Information

Note that the package information provided here is for consultation purposes only. As this information may be updated at regular intervals users are reminded to consult the <u>Holtek website</u> for the latest version of the <u>Package/Carton Information</u>.

Additional supplementary information with regard to packaging is listed below. Click on the relevant section to be transferred to the relevant website page.

- Further Package Information (include Outline Dimensions, Product Tape and Reel Specifications)
- Packing Meterials Information
- Carton information



8-pin SOP (150mil) Outline Dimensions





Symbol	Dimensions in inch					
Symbol	Min.	Nom.	Max.			
A		0.236 BSC				
В		0.154 BSC				
С	0.012	—	0.020			
C'	0.193 BSC					
D	— — 0.069					
E		0.050 BSC				
F	0.004	—	0.010			
G	0.016	_	0.050			
Н	0.004	_	0.010			
α	0°	_	8°			

Symbol	Dimensions in mm			
Symbol	Min.	Nom.	Max.	
A		6.00 BSC		
В		3.90 BSC		
С	0.31	_	0.51	
C'	4.90 BSC			
D	—	—	1.75	
E		1.27 BSC		
F	0.10	—	0.25	
G	0.40	_	1.27	
Н	0.10	_	0.25	
α	0°	—	8°	



5-pin SOT23 Outline Dimensions







Symbol	Dimensions in inch			
Symbol	Min.	Nom.	Max.	
A	_	_	0.057	
A1	—	—	0.006	
A2	0.035	0.045	0.051	
b	0.012	—	0.020	
С	0.003	_	0.009	
D		0.114 BSC		
E		0.063 BSC		
е		0.037 BSC		
e1	0.075 BSC			
Н	0.110 BSC			
L1	0.024 BSC			
θ	0°	_	8°	

Symbol	Dimensions in mm		
	Min.	Nom.	Max.
A	_	_	1.45
A1	_	_	0.15
A2	0.90	1.15	1.30
b	0.30	—	0.50
С	0.08	_	0.22
D	2.90 BSC		
E	1.60 BSC		
е	0.95 BSC		
e1	1.90 BSC		
Н	2.80 BSC		
L1	0.60 BSC		
θ	0°	—	8°



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