





ON Semiconductor®

# FAN156 Low Voltage Comparator

## Features

- Low Supply Current:  $I_{DD}$  6  $\mu$ A (Typical)
- Single Power Supply Operation
- Wide Common-Mode Input Voltage Range
- Push-Pull Output Circuit
- Low Input Bias Current
- Internal Hysteresis
- Packaged in MicroPak™ 6

## Applications

- Mobile Phones
- Alarm and Security Systems
- Personal Digital Assistants

## Description

The FAN156 is a low-power single comparator that typically consumes less than 10  $\mu$ A of supply current. It is guaranteed to operate at a low voltage of 1.6 V and is fully operational up to 5.5 V, making it convenient for use in 1.8, 3.0 V, and 5.0 V systems.

The FAN156 has a complementary push-pull P- and N-channel output stage capable of driving a rail-to-rail output swing with a load ranging up to 5.0 mA.

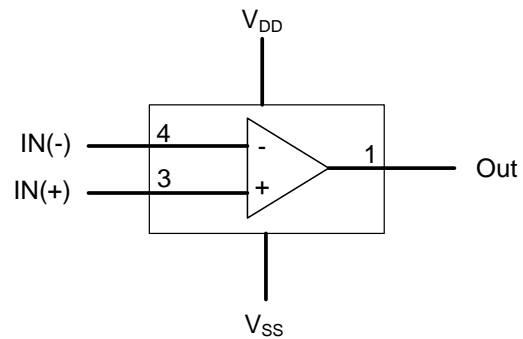


Figure 1. Functional Diagram

## Ordering Information

Part Number	Top Mark	Operating Temperature Range	Package	Packing Method
FAN156L6X	CN	-40 to 85°C	6-Lead, MicroPak™, 1 x 1.45 mm Wide	5000 Units on Tape and Reel

## Pin Configuration

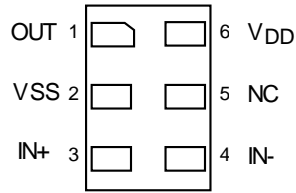


Figure 2. Pin Configuration (Top-Through View)

## Pin Definitions

Pin #	Name	Description
1	OUT	Comparator Output
2	V <sub>SS</sub>	Negative Supply Voltage
3	IN+	Non-Inverting Input
4	IN-	Inverting Input
5	NC	No Connect
6	V <sub>DD</sub>	Positive Supply Voltage

## Function Table

Inputs	Outputs
IN(-) > IN(+)	Output LOW
IN(+) > IN(-)	Output HIGH

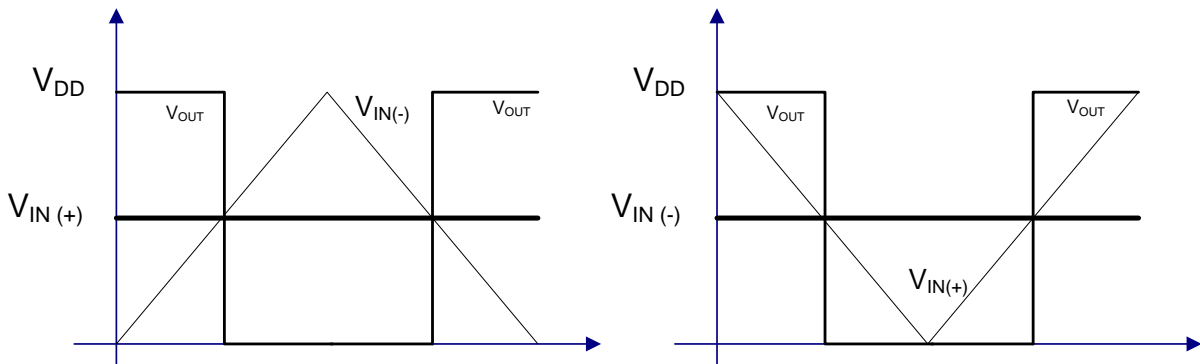


Figure 3. V<sub>IN</sub> vs. V<sub>OUT</sub>

## Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter	Condition	Min.	Max.	Unit
$V_{DD}$ to $V_{SS}$	Supply Voltage		-3.0	+3.0	V
			0	6.0	
$DV_{IN}$	Differential Input Voltage			±6	
$V_{IN}$	Input Voltage			$V_{SS}$ to $V_{DD}$	V
$t_s$	Output Short Circuit Duration <sup>(1)</sup>			Indefinite	s
$T_J$	Junction Temperature			+150	°C
$T_{STG}$	Storage Temperature Range		-65	+150	°C
$P_D$	Power Dissipation			194	mW
$\Theta_{JA}$	Thermal Resistance			335	°C/W
ESD	IEC 61000-4-2 System ESD	Air Gap		15	kV
		Contact		8	
	JEDEC JESD22-A114, Human Body Model	All Pins		8	
		Pin to Pin: IN(-), IN(+) to $V_{DD}$ or $V_{SS}$		12	
	JEDEC JESD22-C101, Charged Device Model	All Pins		2	

### Note:

- The maximum total power dissipation must not be exceeded.

## Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. ON Semiconductor does not recommend exceeding them or designing to Absolute Maximum Ratings.

Symbol	Parameter	Condition	Min.	Max.	Unit
$V_{DD}$ to $V_{SS}$	Power Supply		-2.75	+2.75	V
			0	5.50	
$V_{DD}$	Power Supply	$V_{SS}$ 0 V	1.6	5.5	V
$V_{IN}$	Input Voltage			$V_{SS}$ to $V_{DD}$	V
$I_{OH}/I_{OL}$	Output Sink/Source Current	$V_{DD}$ 5.0 V		5	mA
		$V_{DD}$ 3.0 V		3	
		$V_{DD}$ 1.6 V		1	
$T_A$	Operating Temperature, Free Air		-40	+85	°C

### Electrical Characteristics

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
<b>V<sub>DD</sub>=5.5V, V<sub>SS</sub>=GND, and T<sub>A</sub>=+25°C</b>						
V <sub>HYS</sub>	Input Hysteresis	V <sub>CM</sub> =0.5 V <sub>DD</sub>		4		mV
V <sub>IO</sub>	Input Offset Voltage <sup>(2)</sup>	V <sub>CM</sub> =0.5 V <sub>DD</sub>	-15	±1	+15	mV
I <sub>IO</sub>	Input Offset Current			10		pA
I <sub>I</sub>	Input Bias Current			10		pA
V <sub>CM</sub>	Common Mode Input Voltage		V <sub>SS</sub>		V <sub>DD</sub>	V
CMRR	Common Mode Rejection Ratio <sup>(3)</sup>	V <sub>CM</sub> =V <sub>DD</sub>		68		dB
I <sub>DD</sub>	Supply Current			6	17	μA
PSRR	Power Supply Rejection Ratio <sup>(3)</sup>	ΔV <sub>DD</sub> =0.5 V	45	80		dB
I <sub>OS</sub>	Output Short Circuit Current	V <sub>O</sub> =V <sub>DD</sub>		60		mA
		V <sub>O</sub> =V <sub>SS</sub>		90		
V <sub>OL</sub>	Low-Level Output Voltage	I <sub>SINK</sub> =5.0 mA		0.1	0.3	V
V <sub>OH</sub>	High-Level Output Voltage	I <sub>SOURCE</sub> =5.0 mA	5.2	5.4		V
t <sub>PLH</sub>	Propagation Delay (Turn-On)	Overdrive 20 mV, C <sub>L</sub> =15 pF		0.40		μs
t <sub>PHL</sub>	Propagation Delay (Turn-Off)	Overdrive=20 mV, C <sub>L</sub> =15 pF		0.42		μs
t <sub>TLH</sub>	Response Time, Output Rise/Fall <sup>(4)</sup>	C <sub>L</sub> =50 pF		4.0		ns
t <sub>THL</sub>				5.4		
<b>V<sub>DD</sub>=3V, V<sub>SS</sub>=GND, and T<sub>A</sub>=+25°C</b>						
V <sub>HYS</sub>	Input Hysteresis	V <sub>CM</sub> =0.5 V <sub>DD</sub>		4		mV
V <sub>IO</sub>	Input Offset Voltage <sup>(2)</sup>	V <sub>CM</sub> =0.5 V <sub>DD</sub>	-15	±1	+15	mV
I <sub>IO</sub>	Input Offset Current			10		pA
I <sub>I</sub>	Input Bias Current			10		pA
V <sub>CM</sub>	Common Mode Input Voltage		V <sub>SS</sub>		V <sub>DD</sub>	V
CMRR	Common Mode Rejection Ratio <sup>(3)</sup>	V <sub>CM</sub> =V <sub>DD</sub>		60		dB
I <sub>DD</sub>	Supply Current			5.5	15.0	μA
PSRR	Power Supply Rejection Ratio <sup>(3)</sup>	ΔV <sub>DD</sub> =0.5 V	45	80		dB
I <sub>OS</sub>	Output Short Circuit Current	V <sub>O</sub> =V <sub>DD</sub>		27		mA
		V <sub>O</sub> =V <sub>SS</sub>		35		
V <sub>OL</sub>	Low-Level Output Voltage	I <sub>SINK</sub> =3.0 mA		0.15	0.35	V
V <sub>OH</sub>	High-Level Output Voltage	I <sub>SOURCE</sub> =3.0 mA	2.65	2.85		V
t <sub>PLH</sub>	Propagation Delay (Turn-On)	Overdrive=20 mV, C <sub>L</sub> =15 pF		0.45		μs
t <sub>PHL</sub>	Propagation Delay (Turn-Off)	Overdrive=20 mV, C <sub>L</sub> =15 pF		0.47		μs
t <sub>TLH</sub>	Response Time, Output Rise/Fall <sup>(4)</sup>	C <sub>L</sub> =50pF		6.1		ns
t <sub>THL</sub>				6.2		

Continued on the following page...

**Electrical Characteristics** (Continued)

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
<b>V<sub>DD</sub> 1.6V, V<sub>SS</sub> GND, and T<sub>A</sub>=+25°C</b>						
V <sub>HYS</sub>	Input Hysteresis	V <sub>CM</sub> =0.5 V <sub>DD</sub>		3.5		mV
V <sub>IO</sub>	Input Offset Voltage <sup>(2)</sup>	V <sub>CM</sub> =0.5 V <sub>DD</sub>	-15	±1	+15	mV
I <sub>IO</sub>	Input Offset Current			10		pA
I <sub>I</sub>	Input Bias Current			10		pA
V <sub>CM</sub>	Common Mode Input Voltage		V <sub>SS</sub>		V <sub>DD</sub>	V
CMRR	Common Mode Rejection Ratio <sup>(3)</sup>	V <sub>CM</sub> =V <sub>DD</sub>		56		dB
I <sub>DD</sub>	Supply Current			5	15	μA
PSRR	Power Supply Rejection Ratio <sup>(3)</sup>	ΔV <sub>DD</sub> =0.5 V	45	80		dB
I <sub>OS</sub>	Output Short Circuit Current	V <sub>O</sub> =V <sub>DD</sub>		5.5		mA
		V <sub>O</sub> =V <sub>SS</sub>		7.5		
V <sub>OL</sub>	Low-Level Output Voltage	I <sub>SINK</sub> =1.0 mA		0.10	0.25	V
V <sub>OH</sub>	High-Level Output Voltage	I <sub>SOURCE</sub> =1.0 mA	1.35	1.50		V
t <sub>PLH</sub>	Propagation Delay (Turn-On)	Overdrive=20 mV, C <sub>L</sub> =15 pF		0.52		μs
t <sub>PHL</sub>	Propagation Delay (Turn-Off)	Overdrive=20 mV, C <sub>L</sub> =15 pF		0.54		μs
t <sub>TLH</sub>	Response Time, Output Rise/Fall <sup>(4)</sup>	C <sub>L</sub> =50 pF		16.5		ns
t <sub>THL</sub>				13.0		

**Notes:**

- Differential input switching level is guaranteed at the minimum or maximum offset voltage, minus or plus half the maximum hysteresis voltage.
- Guaranteed by design and characterization data.
- Input signal: 1 kHz, square-wave signal with 10 ns edge rate.

## Typical Performance Characteristics

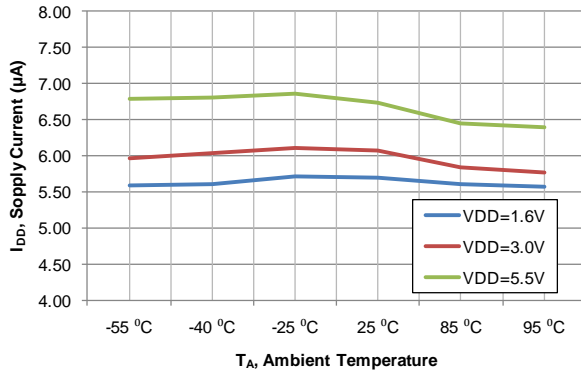


Figure 4. Supply Current vs. Temperature

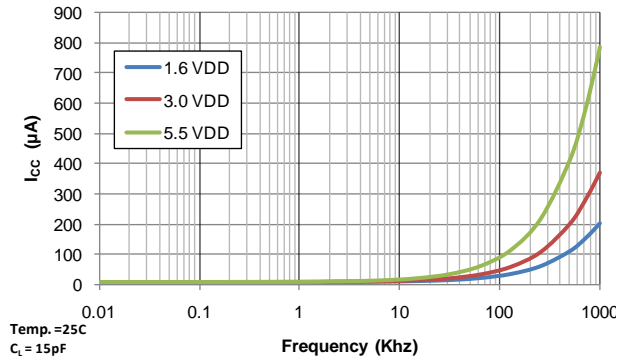


Figure 5. Supply Current vs. Output Transition Frequency

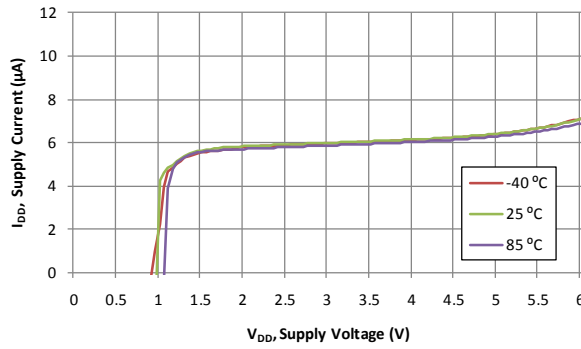


Figure 6. Supply Current vs. Supply Voltage

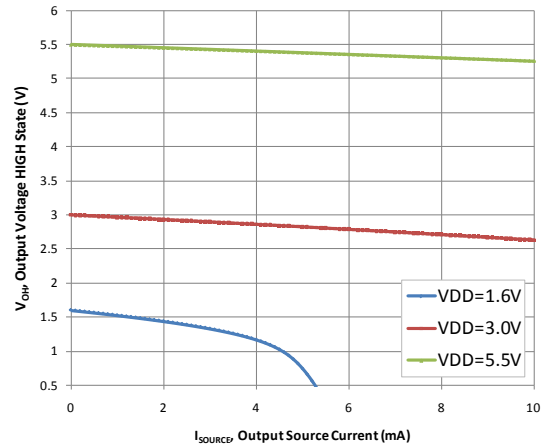


Figure 7. Output HIGH vs. Output Drive Current

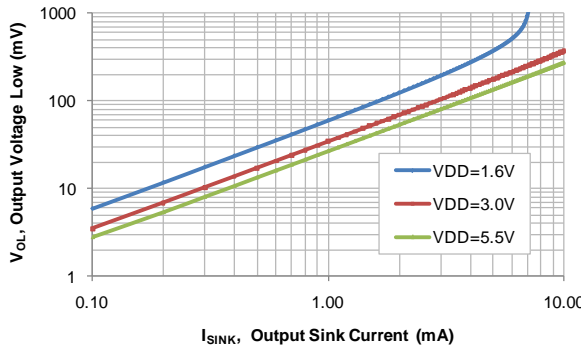


Figure 8. Output LOW vs. Output Drive Current

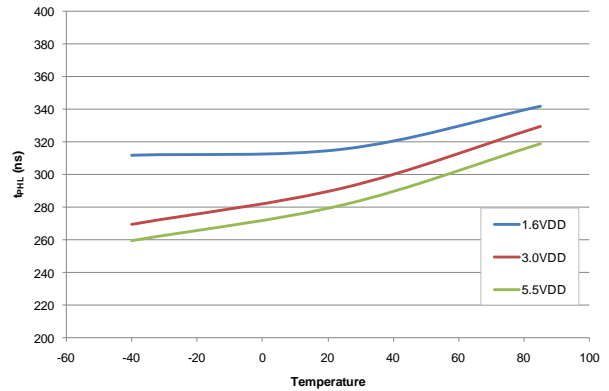


Figure 9. Propagation Delay (t<sub>PHL</sub>) vs. Temperature

Typical Performance Characteristics (Continued)

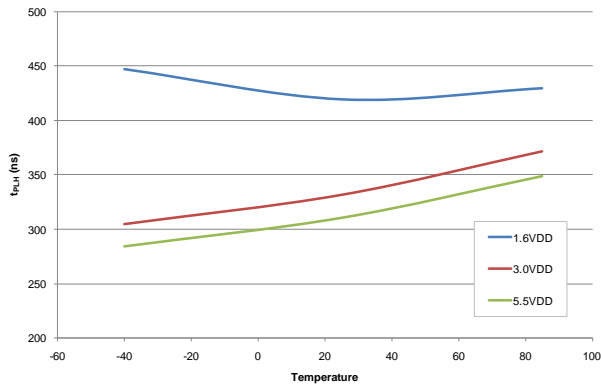


Figure 10. Propagation Delay ( $t_{PLH}$ ) vs. Temperature

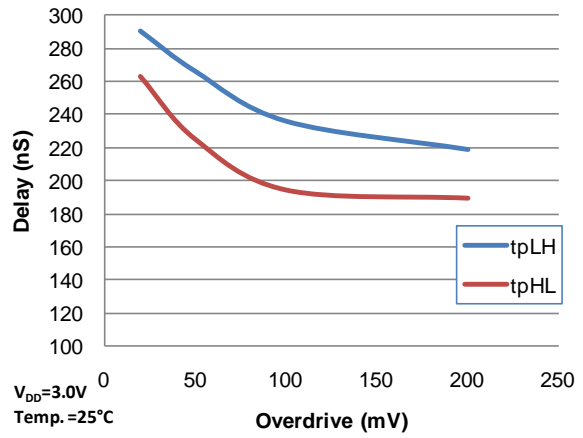


Figure 11. Propagation Delay vs. Input Overdrive

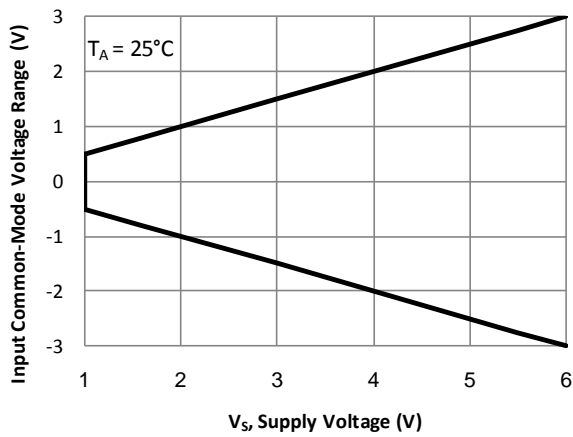


Figure 12. Input Common-Mode Voltage Range vs. Supply Voltage

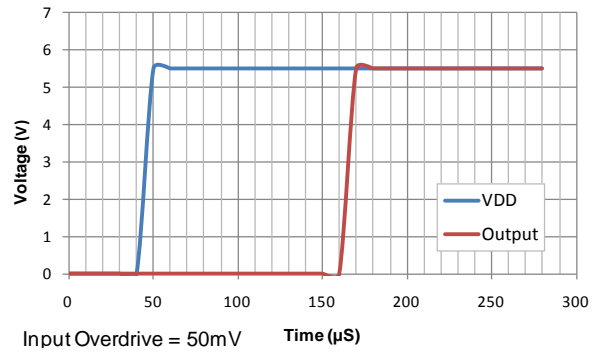


Figure 13. Power-Up Delay



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