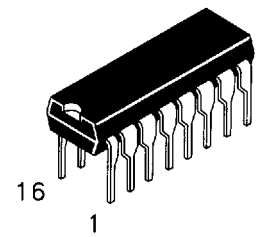
Available Q2, 1995

# Dual $\overline{JK}$ Positive Edge-Triggered Flip-Flop

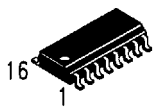
**DV74AC109**
**DV74ACT109**

This device consists of two high speed JK flip flops. Both normal and inverted outputs are available. The device can be asynchronously set or reset, or synchronously clocked.

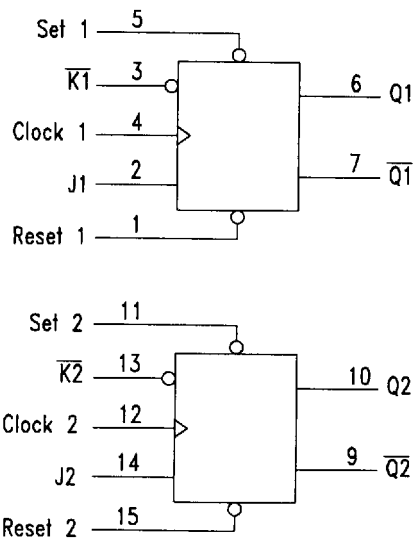
- **Advanced very high speed CMOS**
- **Outputs source/sink 24 mA**
- **Transmission line driving 50 ohms**
- **ACT has TTL compatible inputs**
- **AC Device Operation from 2 to 6 volts guaranteed**
- **DC & AC Parameters guaranteed over –40 to +85°C**




N Suffix
Plastic DIP
AVG-003 Case

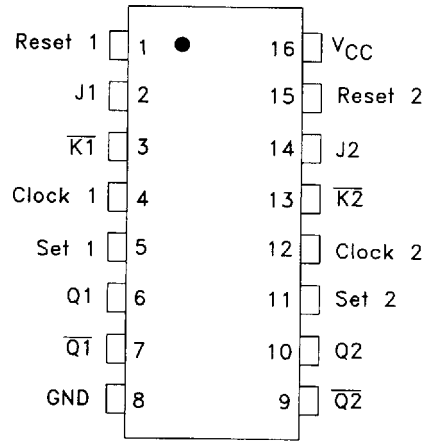



D Suffix
Plastic SOP
AVG-004 Case




PIN 16 = $V_{CC}$
PIN 8 = GND

PIN ASSIGNMENT




**TRUTH TABLE**

| Inputs | | | | | Output | |
|---|---|---|---|---|---|---|
| **Set** | **Reset** | **Clock** | **J** | **$\overline{K}$** | **Q** | **$\overline{Q}$** |
| L | H | X | X | X | H | L |
| H | L | X | X | X | L | H |
| L | L | X | X | X | H* | H* |
| H | H | ↑ | L | L | L | H |
| H | H | ↑ | H | L | Toggle | Toggle |
| H | H | ↑ | L | H | Qo | $\overline{Qo}$ |
| H | H | ↑ | H | H | H | L |
| H | H | L | X | X | Qo | $\overline{Qo}$ |

H=High Logic Level L=Low Logic Level
X=Don't Care Qo=Previous State of Q
↑ = Low to High Transition
* Both outputs will remain high as long as Set and Reset are low, but the output states are unpredictable if Set and Reset go high simultaneously

## ABSOLUTE MAXIMUM RATINGS

Maximum ratings are those values beyond which damage to the device may occur.

| Symbol | Parameter | AC109, ACT109 | Unit |
|---|---|---|---|
| $V_{CC}$ | DC Supply Voltage (Referenced to GND) | – 0.5 to +7.0 | V |
| $V_{IN}$ | DC Input Voltage (Referenced to GND) | – 0.5 to $V_{CC}$ +0.5 | V |
| $V_{OUT}$ | DC Output Voltage (Referenced to GND) | – 0.5 to $V_{CC}$ +0.5 | V |
| $I_{IN}$ | DC Input Current, per Pin | ±20 | mA |
| $I_{OUT}$ | DC Output Sink/Source Current, per Pin | ±50 | mA |
| $I_{CC}$ | DC $V_{CC}$ or GND Current per Output Pin | ±50 | mA |
| Tstg | Storage Temperature | – 65 to +150 | °C |

## GUARANTEED OPERATING CONDITIONS

| Symbol | Parameter | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{CC}$ | Supply Voltage | 'AC | 2.0 | 5.0 | 6.0 | V |
| | | 'ACT | 4.5 | 5.0 | 5.5 | |
| $V_{IN}$, $V_{OUT}$ | DC Input Voltage, Output Voltage, (Ref. to GND) | | 0 | | $V_{CC}$ | V |
| $t_r$, $t_f$ | Input Rise and Fall Time (Note 1) **'AC** Devices | $V_{CC}$ @ 3.0 V | | | 150 | ns/V |
| | | $V_{CC}$ @ 4.5 V | | | 40 | ns/V |
| | | $V_{CC}$ @ 5.5 V | | | 25 | ns/V |
| $t_r$, $t_f$ | Input Rise and Fall Time (Note 2) **'ACT** Devices | $V_{CC}$ @ 4.5 V | | | 10 | ns/V |
| | | $V_{CC}$ @ 5.5 V | | | 8.0 | ns/V |
| $T_A$ | Operating Ambient Temperature Range | | –40 | 25 | 85 | °C |
| $C_{IN}$ | Input Capacitance | $V_{CC}$ = 5.0 V | | 4.5 | | pF |
| $C_{PD}$ | Power Dissipation Capacitance | $V_{CC}$ = 5.0 V | | 35 | | pF |

1. $V_{IN}$ from 30% to 70% $V_{CC}$
2. $V_{IN}$ from 0.8 to 2.0 V



## DC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Conditions | Vcc (V) | AC109 | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | TA = +25°C | | TA = –40 to +85°C | |
| | | | | Typ | Guaranteed Limits | | |
| $V_{IH}$ | Minimum High Level Input Voltage | $V_{OUT}$ = 0.1V or $V_{CC}$ – 0.1 V | 3.0<br>4.5<br>5.5 | 1.5<br>2.25<br>2.75 | 2.1<br>3.15<br>3.85 | 2.1<br>3.15<br>3.85 | V |
| $V_{IL}$ | Maximum Low Level Input Voltage | $V_{OUT}$ = 0.1V or $V_{CC}$ – 0.1 V | 3.0<br>4.5<br>5.5 | 1.5<br>2.25<br>2.75 | 0.9<br>1.35<br>1.65 | 0.9<br>1.35<br>1.65 | V |
| $V_{OH}$ | Minimum High Level Output Voltage | $I_{OUT}$= –50 µA | 3.0<br>4.5<br>5.5 | 2.99<br>4.49<br>5.49 | 2.9<br>4.4<br>5.4 | 2.9<br>4.4<br>5.4 | V |
| | | $V_{IN}$ = $V_{IL}$ or $V_{IH}$<br>$I_{OH}$ –12mA<br>$I_{OH}$ –24mA<br>$I_{OH}$ –24mA | 3.0<br>4.5<br>5.5 | | 2.56<br>3.86<br>4.86 | 2.46<br>3.76<br>4.76 | V |

## DC ELECTRICAL CHARACTERISTICS (continued)

| Symbol | Parameter | Conditions | $V_{CC}$ (V) | AC109 | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | TA = +25°C | | TA = –40 to +85°C | |
| | | | | Typ | Guaranteed Limits | | |
| $V_{OL}$ | Maximum Low Level Output Voltage | $I_{OUT}$ = 50 µA | 3.0<br>4.5<br>5.5 | 0.002<br>0.001<br>0.001 | 0.1<br>0.1<br>0.1 | 0.1<br>0.1<br>0.1 | V |
| | | $V_{IN}$ = $V_{IL}$ or $V_{IH}$<br>12mA<br>$I_{OL}$ 24mA<br>24mA | 3.0<br>4.5<br>5.5 | | 0.36<br>0.36<br>0.36 | 0.44<br>0.44<br>0.44 | V |
| $I_{IN}$ | Maximum Input Leakage Current | $V_{IN}$ = $V_{CC}$ or GND | 5.5 | | ±0.1 | ±1.0 | µA |
| $I_{CC}$ | Maximum Quiescent Supply Current | $V_{IN}$ = $V_{CC}$ or GND | 5.5 | | 4.0 | 40 | µA |

## AC CHARACTERISTICS over full operating conditions

| Symbol | Parameter | $V_{CC}$ ±10% (V) | AC109 | | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | $T_A$ = +25°C $C_L$ = 50 pF | | $T_A$ = – 40°C to +85°C $C_L$ = 50 pF | | |
| | | | Min | Max | Min | Max | |
| $f_{MAX}$ | Maximum Clock Frequency | 3.3 | 125<br>150 | | 100<br>125 | | MHz |
| $t_{PLH}$ | Propagation Delay Clock to Output | 3.3<br>5.0 | 4.0<br>2.5 | 13.5<br>10.0 | 3.5<br>2.0 | 16.0<br>10.5 | ns |
| $t_{PHL}$ | Propagation Delay Clock to Output | 3.3<br>5.0 | 3.0<br>2.0 | 14.0<br>10.0 | 3.0<br>1.5 | 14.5<br>10.5 | ns |
| $t_{PLH}$ | Propagation Delay Reset or Set to Output | 3.3<br>5.0 | 3.0<br>2.0 | 12.0<br>9.0 | 2.5<br>2.0 | 13.0<br>10.0 | ns |
| $t_{PHL}$ | Propagation Delay Reset or Set to Output | 3.3<br>5.0 | 3.0<br>2.0 | 12.0<br>9.5 | 3.0<br>2.0 | 13.5<br>10.5 | ns |
| $t_S$ | Setup Time, HIGH or LOW Data Input to Clock | 3.3<br>5.0 | 6.5<br>4.5 | | 7.5<br>5.0 | | ns |
| $t_h$ | Hold Time, HIGH or LOW Data Input to Clock | 3.3<br>5.0 | 0<br>0.5 | | 0<br>0.5 | | ns |
| $t_w$ | Pulse Width Clock, Set or Reset | 3.3<br>5.0 | 4.0<br>3.5 | | 4.5<br>3.5 | | ns |
| $t_{rec}$ | Recovery Time Set or Reset to Clock | 3.3<br>5.0 | 0<br>0 | | 0<br>0 | | ns |

# ACT — 109

## DC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Conditions | $V_{CC}$ (V) | ACT109 | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | TA = +25°C | | TA = –40 to +85°C | |
| | | | | Typ | Guaranteed Limits | | |
| $V_{IH}$ | Minimum High Level Input Voltage | $V_{OUT}$ = 0.1V or $V_{CC}$ – 0.1 V | 4.5<br>5.5 | 1.5<br>1.5 | 2.0<br>2.0 | 2.0<br>2.0 | V |
| $V_{IL}$ | Maximum Low Level Input Voltage | $V_{OUT}$ = 0.1V or $V_{CC}$ – 0.1 V | 4.5<br>5.5 | 1.5<br>1.5 | 0.8<br>0.8 | 0.8<br>0.8 | V |

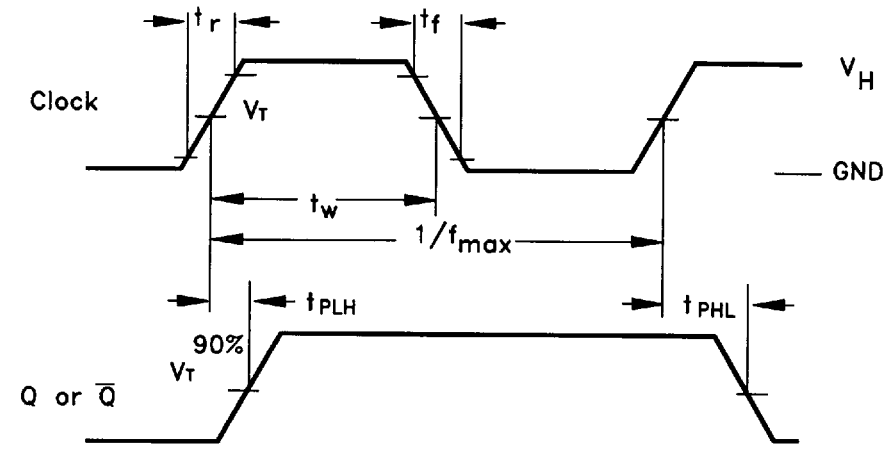
## DC ELECTRICAL CHARACTERISTICS(continued)

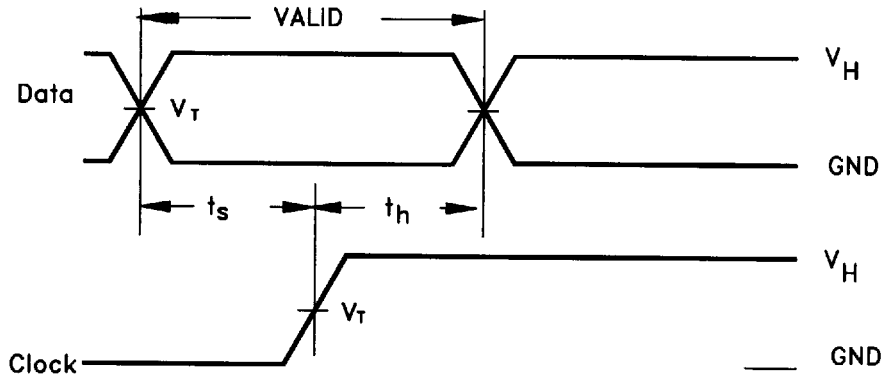
| Symbol | Parameter | Conditions | $V_{CC}$ (V) | ACT109 | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | TA = +25°C | | TA = –40 to +85°C | |
| | | | | Typ | Guaranteed Limits | | |
| $V_{OH}$ | Minimum High Level Output Voltage | $I_{OUT}$ = –50 µA | 4.5<br>5.5 | 4.49<br>5.49 | 4.4<br>5.4 | 4.4<br>5.4 | V |
| | | $V_{IN}$ = $V_{IL}$ or $V_{IH}$<br>$I_{OH}$ –24mA<br>–24 mA | 4.5<br>5.5 | | 3.86<br>4.86 | 3.76<br>4.76 | V |
| $V_{OL}$ | Maximum Low Level Output Voltage | $I_{OUT}$ = 50 µA | 4.5<br>5.5 | 0.001<br>0.001 | 0.1<br>0.1 | 0.1<br>0.1 | V |
| | | $V_{IN}$ = $V_{IL}$ or $V_{IH}$<br>$I_{OL}$ 24mA<br>24 mA | 4.5<br>5.5 | | 0.36<br>0.36 | 0.44<br>0.44 | V |
| $I_{IN}$ | Maximum Input Leakage Current | $V_{IN}$ = VCC or GND | 5.5 | | ±0.1 | ±1.0 | µA |
| $\Delta I_{CCT}$ | Additional Max $I_{CC}$/Input | $V_{IN}$ = $V_{CC}$ – 2.1 V | 5.5 | 0.6 | | 1.5 | mA |
| $I_{CC}$ | Maximum Quiescent Supply Current | $V_{IN}$ = $V_{CC}$ or GND | 5.5 | | 4.0 | 40 | µA |

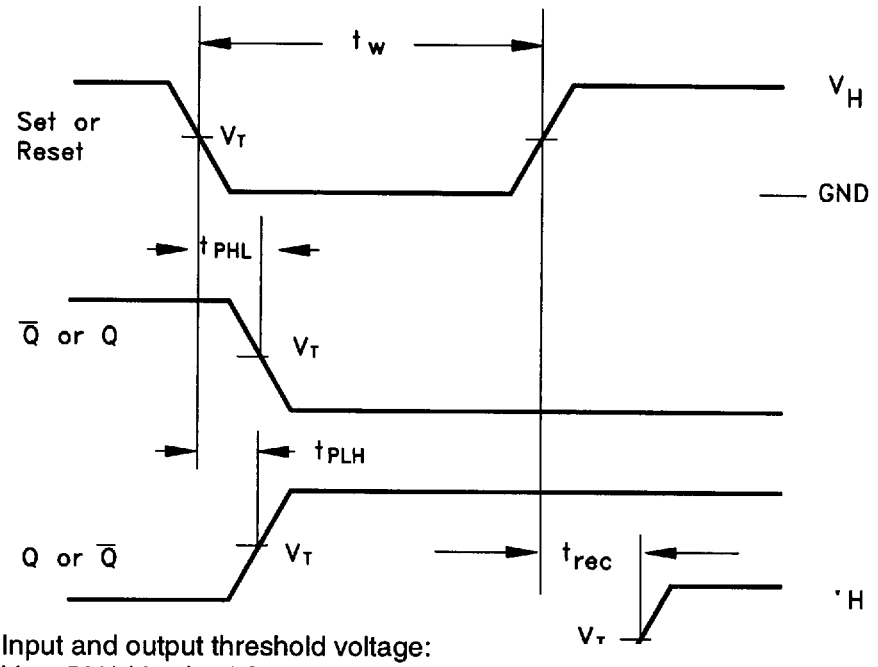
## AC CHARACTERISTICS over full operating conditions

| Symbol | Parameter | $V_{CC}$ ±10% (V) | ACT109 | | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | $T_A$ = +25°C $C_L$ = 50 pF | | $T_A$ = – 40°C to +85°C $C_L$ = 50 pF | | |
| | | | Min | Max | Min | Max | |
| $f_{MAX}$ | Maximum Clock Frequency | 5.0 | 145 | | 125 | | MHz |
| $t_{PLH}$ | Propagation Delay, Clock to Output | 5.0 | 4.0 | 11.0 | 3.5 | 13.0 | ns |
| $t_{PHL}$ | Propagation Delay, Clock to Output | 5.0 | 3.0 | 10.0 | 2.5 | 11.5 | ns |
| $t_{PLH}$ | Propagation Delay, Reset or Set to Output | 5.0 | 2.5 | 9.5 | 2.0 | 10.5 | ns |
| $t_{PHL}$ | Propagation Delay Reset or Set to Output | 5.0 | 2.5 | 10.0 | 2.0 | 11.5 | ns |
| $t_S$ | Setup Time, HIGH or LOW Data Input to Clock | 5.0 | 2.0 | | 2.5 | | ns |
| $t_h$ | Hold Time, HIGH or LOW Data Input to Clock | 5.0 | 2.0 | | 2.0 | | ns |
| $t_w$ | Pulse Width Clock, Set or Reset | 5.0 | 5.0 | | 6.0 | | ns |
| $t_{rec}$ | Recovery Time Set or Reset to Clock | 5.0 | 0 | | 0 | | ns |

## SWITCHING WAVEFORMS




Input and output threshold voltage:
$V_T$ = 50% Vcc for AC; 1.5V for ACT
$V_H$ = Vcc for AC, 3V for ACT