

Description

The 74AHC1G09Q is an automotive compliant single, two-input positive AND gate with an open drain output. The device is designed for operation with a power supply range of 2.0V to 5.5V. The gate performs the positive Boolean function:

$$Y = A \bullet B \text{ or } Y = \overline{\overline{A + B}}$$

A pull-up resistor is required to achieve a high output state.

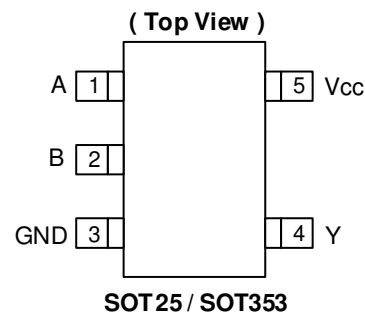
Features

- Grade 1 Ambient Temperature Operation: -40°C to +125°C
- Supply Voltage Range from 2.0V to 5.5V
- 8mA Output Sink at $V_{CC} = 4.5V$
- CMOS Low-Power Consumption
- Schmitt Trigger Action at All Inputs Make the Circuit Tolerant for Slower Input Rise and Fall Time
- Inputs Not Limited by V_{CC}
- Balanced Propagation Delays
- Balanced Drive Capability
- ESD Protection Tested per AEC-Q100
- Exceeds 2000-V Human Body Model (AEC-Q100-002)
- Exceeds 1000-V Charged Device Model (AEC-Q100-011)
- Latch-Up Exceeds 100mA (AEC-Q100-004)
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **The 74AHC1G09Q is suitable for automotive applications requiring specific change control; this part is AEC-Q100 qualified, PPAP capable, and manufactured in IATF 16949 certified facilities.**

<https://www.diodes.com/quality/product-definitions/>

- Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
 2. See <https://www.diodes.com/quality/lead-free/> for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
 3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

Pin Assignments



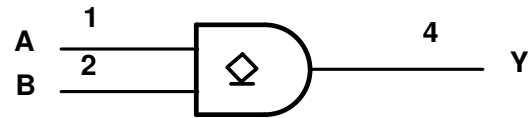
Applications

- General Purpose Logic
- Wide Array of Products, such as:
 - Automotive Applications within Grade 1 Temperature Range
 - Industrial Computing/Controls/Automation
 - High Reliability Networking/Communications
 - Industrial/Agricultural Equipment

Pin Descriptions

Pin Name	Description
A	Data Input
B	Data Input
GND	Ground
Y	Data Output
V _{CC}	Supply Voltage

Logic Diagram



Function Table

Inputs		Output
A	B	Y
H	H	Z
L	X	L
X	L	L

Absolute Maximum Ratings (Notes 4 & 5)

Symbol	Description	Rating	Unit
ESD HBM	Human Body Model ESD Protection	2	kV
ESD CDM	Charged Device Model ESD Protection	1	kV
V _{CC}	Supply Voltage Range	-0.5 to 6.5	V
V _I	Input Voltage Range	-0.5 to 6.5	V
V _O	Voltage Applied to Output in High or Low State	-0.5 to 6.5	V
I _{IK}	Input Clamp Current (V _I < 0)	-20	mA
I _{OK}	Output Clamp Current (V _O < 0)	-20	mA
I _O	Continuous Output Current (V _O = 0 to V _{CC})	+25	mA
I _{CC}	Continuous Current Through V _{CC}	75	mA
I _{GND}	Continuous Current Through GND	-75	mA
T _J	Operating Junction Temperature	-40 to +150	°C
T _{STG}	Storage Temperature	-65 to +150	°C
P _D	Total Power Dissipation (Note 6)	250	mW

- Notes:
- Stresses beyond the absolute maximum can result in immediate failure or reduced reliability. These are stress values and device operation should be within recommend values.
 - Forcing the maximum allowed voltage could cause a condition exceeding the maximum current or conversely forcing the maximum current could cause a condition exceeding the maximum voltage. The ratings of both current and voltage must be maintained within the controlled range.
 - This will need to be derated at higher operating temperatures to prevent exceeding maximum T_J. Refer to package thermal characteristics section.

Recommended Operating Conditions (Note 7)

Symbol	Parameter	Parameter	Min	Max	Unit
V _{CC}	Operating Voltage	—	2	5.5	V
V _{IH}	High-Level Input Voltage	V _{CC} = 2V	1.5	—	V
		V _{CC} = 3V	2.1	—	
		V _{CC} = 5.5V	3.85	—	
V _{IL}	Low-Level Input Voltage	V _{CC} = 2V	—	0.5	V
		V _{CC} = 3V	—	0.9	
		V _{CC} = 5.5V	—	1.65	
V _I	Input Voltage	—	0	5.5	V
V _O	Output Voltage	—	0	5.5	V
I _{OH}	High-Level Output Current	V _{CC} = 2V	—	-50	μA
		V _{CC} = 3.3V ± 0.3V	—	-4	mA
		V _{CC} = 5V ± 0.5V	—	-8	
I _{OL}	Low-Level Output Current	V _{CC} = 2V	—	50	μA
		V _{CC} = 3.3V ± 0.3V	—	4	mA
		V _{CC} = 5V ± 0.5V	—	8	
Δt/ΔV	Input Transition Rise or Fall Rate	V _{CC} = 3.3V ± 0.3V	—	100	ns/V
		V _{CC} = 5V ± 0.5V	—	20	
T _A	Ambient Temperature	—	-40	+125	°C

Note: 7. Unused inputs should be held at V_{CC} or Ground.

Electrical Characteristics (All typical values are at V_{CC} = 3.3V, T_A = +25°C.)

Symbol	Parameter	Test Conditions	V _{CC}	+25°C			-40°C to +85°C		-40°C to +125°C		Unit
				Min	Typ	Max	Min	Max	Min	Max	
V _{OL}	Low Level Output Voltage	V _I = V _{IL} or V _{IH} I _{OL} = 50μA	2V	—	—	0.1	—	0.1	—	0.1	V
			3V	—	—	0.1	—	0.1	—	0.1	
			4.5V	—	—	0.1	—	0.1	—	0.1	
V _{OL}	Low Level Output Voltage	V _I = V _{IL} or V _{IH} I _{OL} = 4mA	3V	—	—	0.36	—	0.44	—	0.55	V
			4.5V	—	—	0.36	—	0.44	—	0.55	
I _I	Input Current	V _I = 5.5V or GND	0 to 5.5V	—	—	±0.1	—	±1	—	±2	μA
I _{CC}	Supply Current	V _I = 5.5V or GND I _O = 0	5.5V	—	—	1	—	10	—	40	μA
I _{CC}	Supply Current	V _I = 5.5V or GND I _O = 0	5.5V	—	—	1	—	10	—	40	μA
C _I	Input Capacitance	V _I = V _{CC} or GND	5.5V	—	2.0	10	—	10	—	10	pF

Package Characteristics

Symbol	Parameter	Package	Test Conditions	Min	Typ	Max	Unit
θ_{JA}	Thermal Resistance Junction-to-Ambient	SOT25	Note 8	—	184	—	°C/W
		SOT353		—	385	—	
θ_{JC}	Thermal Resistance Junction-to-Case	SOT25	Note 8	—	62	—	°C/W
		SOT353		—	164	—	

Note: 8. Device mounted on FR-4 substrate PC board, 2oz copper, with minimum recommended pad layout.

Switching Characteristics

$V_{CC} = 3.3V \pm 0.3V$ (See Figure 1)

Parameter	From (Input)	To (Output)	Test Conditions	+25°C			-40°C to +85°C		-40°C to +125°C		Unit
				Min	Typ	Max	Min	Max	Min	Max	
t_{PD}	A or B	Y	$C_L = 15pF$	0.6	4.5	7.9	0.6	9.5	0.6	10.5	ns
			$C_L = 50pF$	0.6	6.5	11.4	0.6	13.0	0.6	14.5	ns

$V_{CC} = 5V \pm 0.5V$ (See Figure 1)

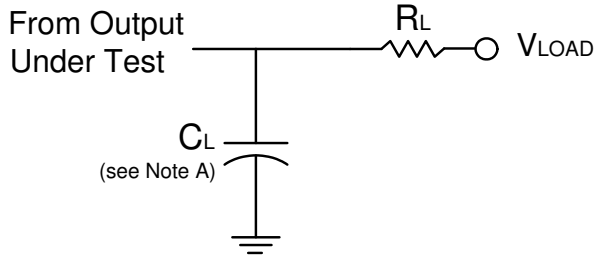
Parameter	From (Input)	To (Output)	Test Conditions	+25°C			-40°C to +85°C		-40°C to +125°C		Unit
				Min	Typ	Max	Min	Max	Min	Max	
t_{PD}	A or B	Y	$C_L = 15pF$	0.6	3.5	5.5	0.6	6.5	0.6	7.0	ns
			$C_L = 50pF$	0.6	4.9	7.5	0.6	8.5	0.6	9.5	ns

Operating Characteristics

$T_A = +25^\circ C$

Parameter	Test Conditions	$V_{CC} = 5V$	Unit
		Typ	
C_{PD}	f = 1MHz No Load	10	pF

Measurement Information



Test	Condition
t_{PLZ} (See Notes D and F)	V_{LOAD}
t_{PZL} (See Notes D and E)	V_{LOAD}

V_{CC}	Inputs		V_M	V_{LOAD}	C_L	R_L	V_{Δ}
	V_i	t_R/t_F					
$3.3V \pm 0.3V$	V_{CC}	$\leq 3ns$	$V_{CC}/2$	V_{CC}	15pF	1k Ω	0.3V
$3.3V \pm 0.3V$	V_{CC}	$\leq 3ns$	$V_{CC}/2$	V_{CC}	50pF	1k Ω	0.3V
$5V \pm 0.5V$	V_{CC}	$\leq 3ns$	$V_{CC}/2$	V_{CC}	15pF	1k Ω	0.3V
$5V \pm 0.5V$	V_{CC}	$\leq 3ns$	$V_{CC}/2$	V_{CC}	50pF	1k Ω	0.3V

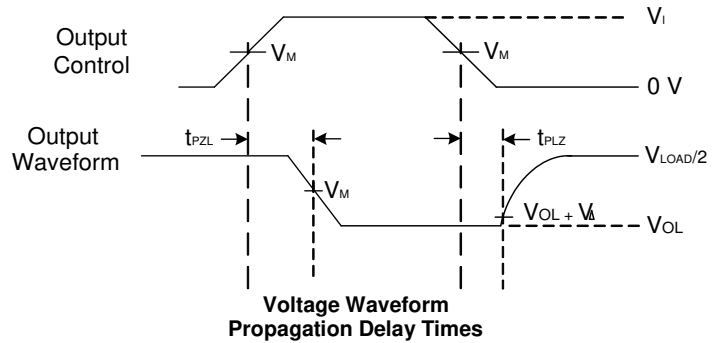
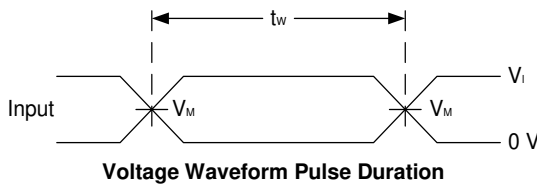
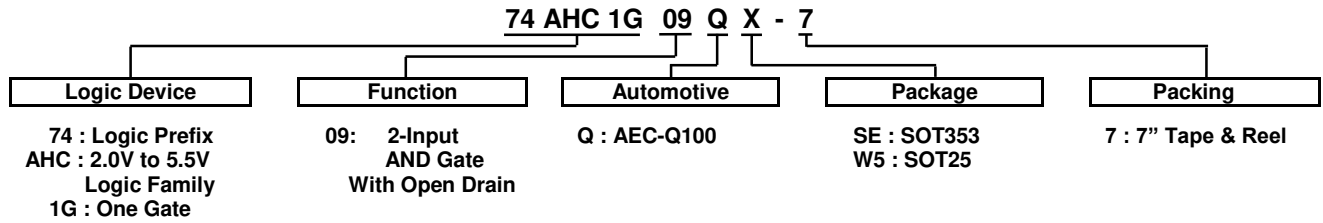


Figure 1. Load Circuit and Voltage Waveforms

- Notes:
- A. Includes test lead and test apparatus capacitance.
 - B. All pulses are supplied at pulse repetition rate $\leq 1MHz$.
 - C. The inputs are measured one at a time with one transition per measurement.
 - D. For the open drain device t_{PLZ} and t_{PZL} are the same as t_{PD} .
 - E. t_{PZL} is measured at V_M .
 - F. t_{PLZ} is measured at $V_{OL} + V_{\Delta}$.

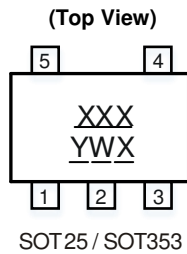
Ordering Information (Note 9)



Part Number	Package Code	Package (Notes 10 & 11)	Package Size	7" Tape and Reel	
				Quantity	Part Number Suffix
74AHC1G09QSE-7	SE	SOT353	2.15mm × 2.1mm × 1.1mm 0.65mm lead pitch	3000/Tape & Reel	-7
74AHC1G09QW5-7	W5	SOT25	3.0mm × 2.8mm × 1.2mm 0.95mm lead pitch	3000/Tape & Reel	-7

Notes: 9. For packaging details, go to our website at <https://www.diodes.com/design/support/packaging/diodes-packaging/>.
 10. Pad layout as shown in Diodes Incorporated's package outline PDFs, which can be found on our website at <http://www.diodes.com/package-outlines.html>.
 11. The taping orientation is located on our website at <https://www.diodes.com/assets/Packaging-Support-Docs/ap02007.pdf>.

Marking Information



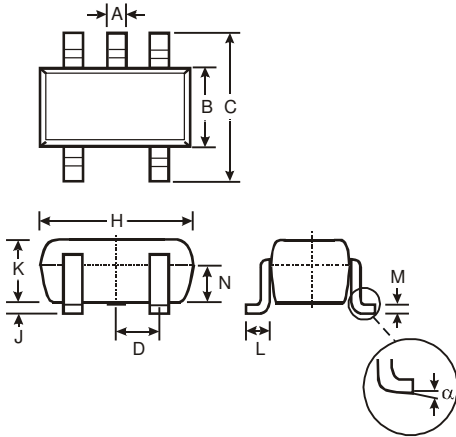
XXX : Identification Code
 Y : Year 0~9
 W : Week: A~ Z 1~ 26 week
 a~ z 27~ 52 week
 z represents week 52 and 53
 X : A~ Z : Internal Code

Part Number	Package	Identification Code
74AHC1G09QW5-7	SOT25	YNQ
74AHC1G09QSE-7	SOT353	YNQ

Package Outline Dimensions

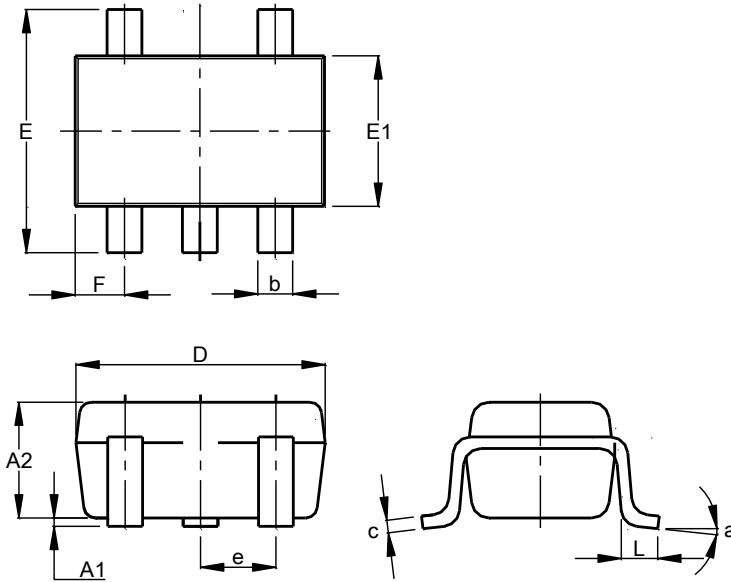
Please see <http://www.diodes.com/package-outlines.html> for the latest version.

(1) Package Type: SOT25



SOT25			
Dim	Min	Max	Typ
A	0.35	0.50	0.38
B	1.50	1.70	1.60
C	2.70	3.00	2.80
D	-	-	0.95
H	2.90	3.10	3.00
J	0.013	0.10	0.05
K	1.00	1.30	1.10
L	0.35	0.55	0.40
M	0.10	0.20	0.15
N	0.70	0.80	0.75
α	0°	8°	-
All Dimensions in mm			

(2) Package Type: SOT353

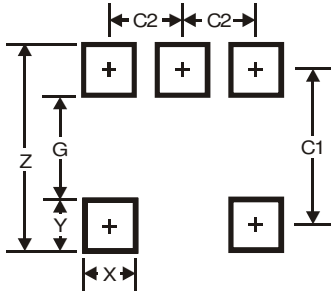


SOT353			
Dim	Min	Max	Typ
A1	0.00	0.10	0.05
A2	0.90	1.00	0.95
b	0.10	0.30	0.25
c	0.10	0.22	0.11
D	1.80	2.20	2.15
E	2.00	2.20	2.10
E1	1.15	1.35	1.30
e	0.650 BSC		
F	0.40	0.45	0.425
L	0.25	0.40	0.30
a	0°	8°	--
All Dimensions in mm			

Suggested Pad Layout

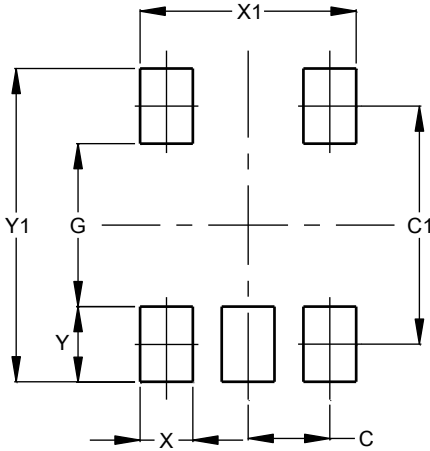
Please see <http://www.diodes.com/package-outlines.html> for the latest version.

(1) Package Type: SOT25



Dimensions	Value
Z	3.20
G	1.60
X	0.55
Y	0.80
C1	2.40
C2	0.95

(2) Package Type: SOT353



Dimensions	Value (in mm)
C	0.650
C1	1.900
G	1.300
X	0.420
X1	1.720
Y	0.600
Y1	2.500

Mechanical Data

SOT25

- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish – Matte Tin Plated Leads, Solderable per MIL-STD-202, Method 208@3
- Weight: 0.0158 grams (Approximate)

SOT353

- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish – Matte Tin Plated Leads, Solderable per MIL-STD-202, Method 208@3
- Weight: 0.0064 grams (Approximate)

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