SINGLE 2-INPUT POSITIVE AND GATE

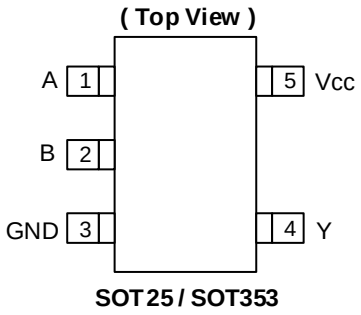
Description

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:

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

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

Pin Assignments



SOT25 / SOT353

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/

Applications

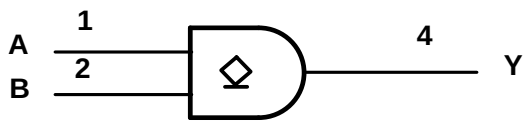
- General Purpose Logic
- Wide Array of Products, such as:
  - Automotive Applications within Grade 1 Temperature Range
  - Industrial Computing/Controls/Automation
  - High Reliability Networking/Communications
  - Industrial/Agricultural Equipment

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 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:
4. 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.
5. 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.
6. 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		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	Vcc	+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	
		$V_I = V_{IL}$ or V_{IH} I_{OL}= 4mA	3V	—	—	0.36	—	0.44	—	0.55	
		$V_I = V_{IL}$ or V_{IH} I_{OL} = 8mA	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 ± 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 ± 0.5V (See Figure 1)

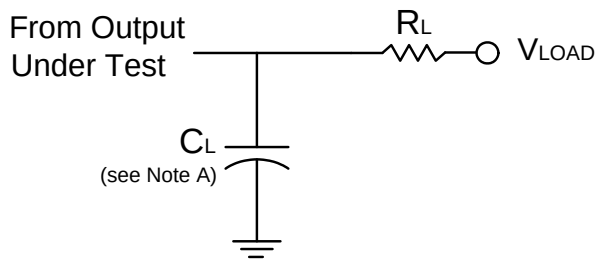
Parameter	From (Input)	To (Output)	Test Conditions	+25°C			-40°C to +85°C		-40°C to +125°C		Unit
				Min	Typ	Max	Min	Max	Min	Max	
t_{PD}	A or B	Y	C_L = 15pF	0.6	3.5	5.5	0.6	6.5	0.6	7.0	ns
			C_L = 50pF	0.6	4.9	7.5	0.6	8.5	0.6	9.5	ns

Operating Characteristics

T_A = +25°C

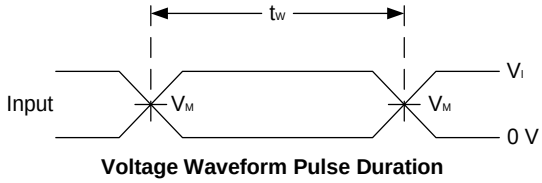
Parameter		Test Conditions	V_{CC} = 5V	Unit
			Typ	
C_{PD}	Power Dissipation Capacitance	f = 1MHz No Load	10	pF

Measurement Information

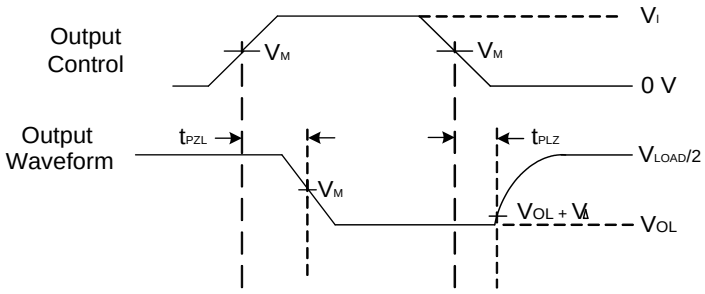


Test	Condition
t_{PLZ} (See Notes D and F)	V_{LOAD}
t_{PZL} (See Notes D and E)	V_{LOAD}

V_{CC}	Inputs		V_M	V_{LOAD}	C_L	R_L	V_Δ
	V_I	t_R/t_F					
3.3V±0.3V	V_{CC}	≤3ns	$V_{CC}/2$	V_{CC}	15pF	1kΩ	0.3V
3.3V±0.3V	V_{CC}	≤3ns	$V_{CC}/2$	V_{CC}	50pF	1kΩ	0.3V
5V±0.5V	V_{CC}	≤3ns	$V_{CC}/2$	V_{CC}	15pF	1kΩ	0.3V
5V±0.5V	V_{CC}	≤3ns	$V_{CC}/2$	V_{CC}	50pF	1kΩ	0.3V



Voltage Waveform Pulse Duration

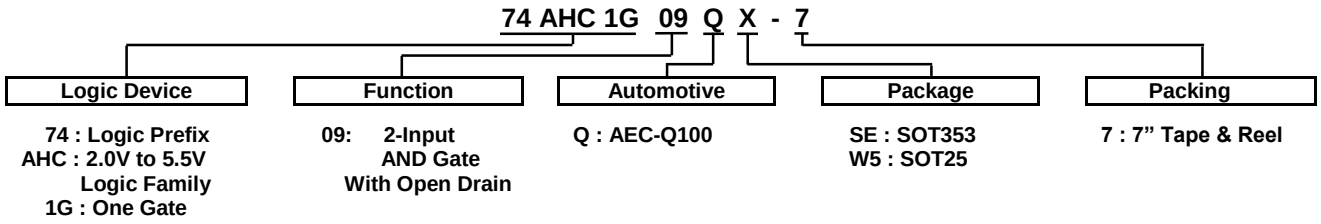


Voltage Waveform
Propagation Delay Times

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 ≤ 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)

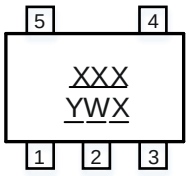


Part Number	Package Code	Package (Notes 10 & 11)	Package Size	7" Tape and Reel	
				Quantity	Part Number Suffix
74AHC1G09QSE-7	SE	SOT353	2.15mm × 2.1mm × 1.1mm 0.65mm lead pitch	3000/Tape & Reel	-7
74AHC1G09QW5-7	W5	SOT25	3.0mm × 2.8mm × 1.2mm 0.95mm lead pitch	3000/Tape & Reel	-7

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

(Top View)



SOT25 / SOT353

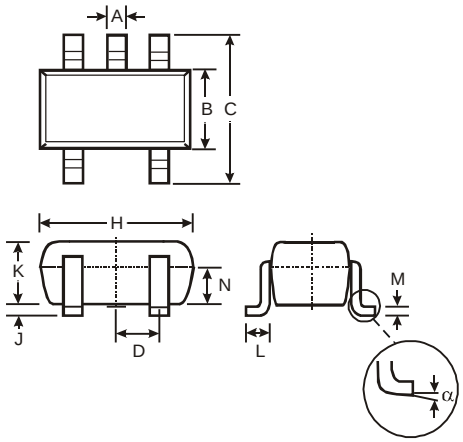
XXX : Identification Code
Y : Year 0~9
W : Week: A~Z 1~26 week
a~z 27~52 week
z represents week 52 and 53
X : A~Z : Internal Code

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

Package Outline Dimensions

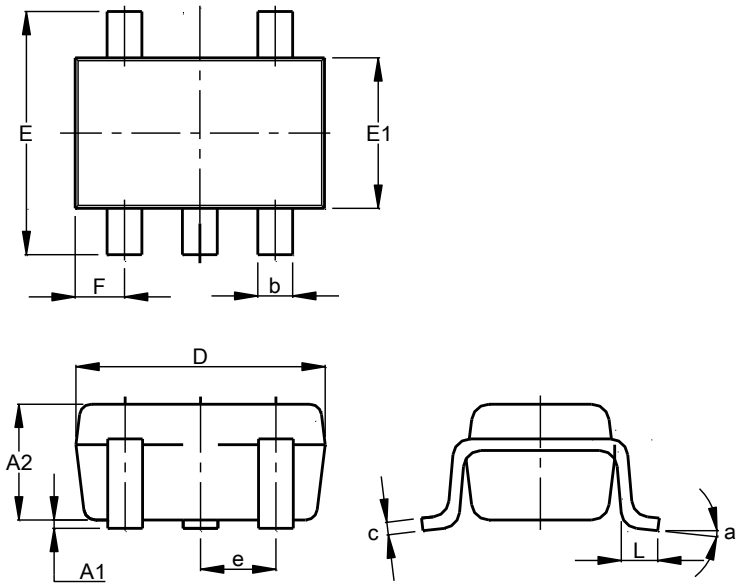
Please see http://www.diodes.com/package-outlines.html for the latest version.

(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

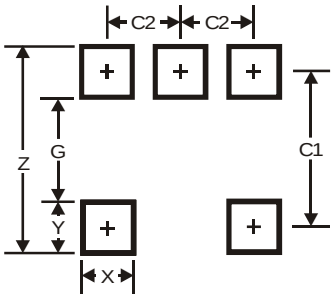


SOT353			
Dim	**Min**	**Max**	**Typ**
A1	0.00	0.10	0.05
A2	0.90	1.00	0.95
b	0.10	0.30	0.25
c	0.10	0.22	0.11
D	1.80	2.20	2.15
E	2.00	2.20	2.10
E1	1.15	1.35	1.30
e	0.650 BSC		
F	0.40	0.45	0.425
L	0.25	0.40	0.30
a	0°	8°	--
All Dimensions in mm			

Suggested Pad Layout

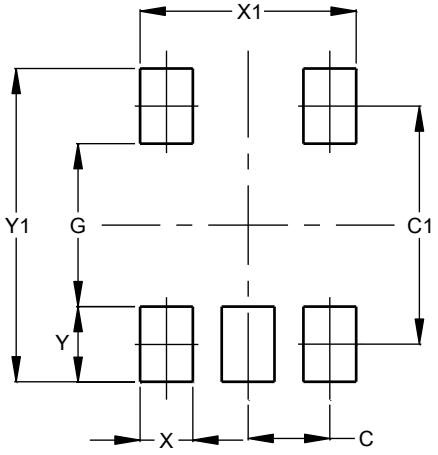
Please see http://www.diodes.com/package-outlines.html for the latest version.

(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 e3
- 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 e3
- Weight: 0.0064 grams (Approximate)

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