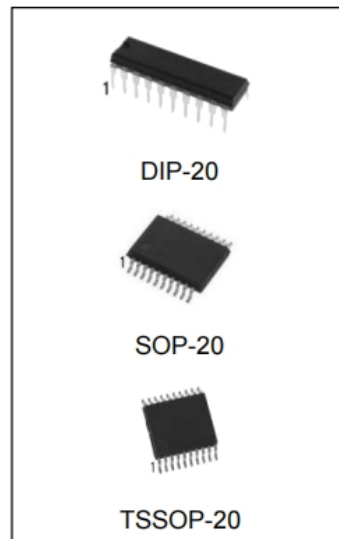


General Description

The 74HCT541 is an 8-bit inverting buffer/line driver with 3-state outputs. The device features two output enables ($\overline{OE1}$ and $\overline{OE2}$). A HIGH on $\overline{OE n}$ causes the outputs to assume a high-impedance OFF-state. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of VCC.

Features

- Input levels: CMOS level
- Inverting outputs
- Specified from -40°C to +105°C
- Packaging information: DIP-20/SOP-20/TSSOP-2



Ordering Information

| Product Model | Package Type | Marking | Packing | Packing Qty |
|---------------|--------------|---------|---------|--------------|
| 74HC541N | DIP-20 | 74HC541 | TUBE | 720pcs/box |
| 74HC541M/TR | SOP-20 | 74HC541 | REEL | 2000pcs/reel |
| 74HC541MT/TR | TSSOP-20 | HC541 | REEL | 2500pcs/reel |

Block Diagram

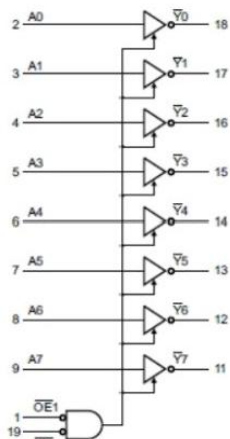


Figure 1. Logic symbol

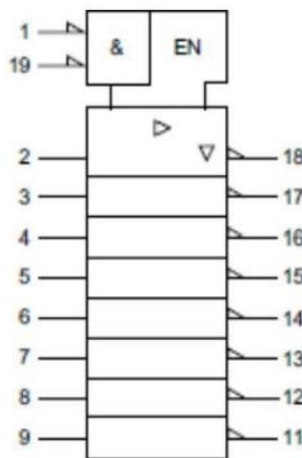


Figure 2. IEC logic symbol

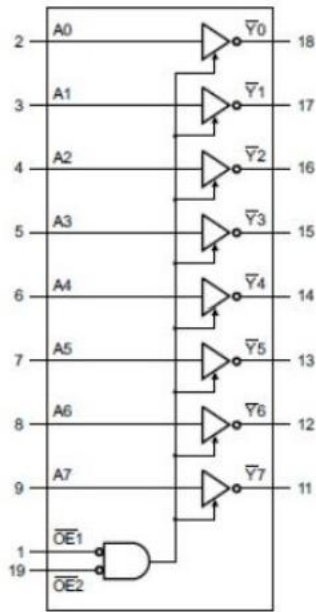


Figure 3. Functional diagram

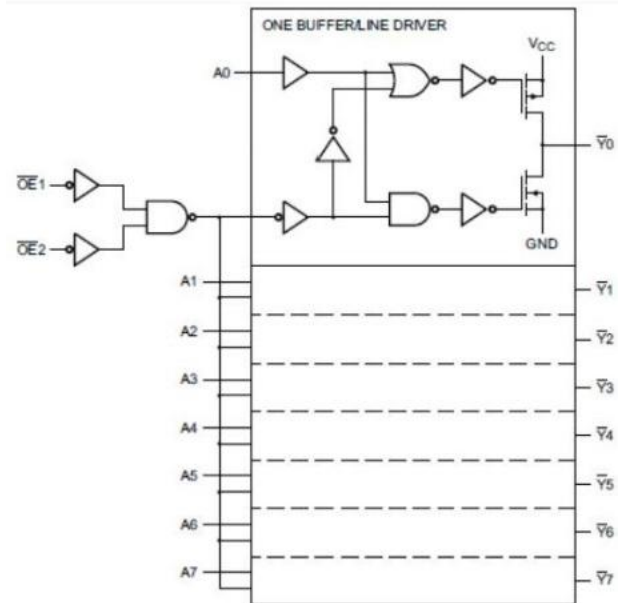
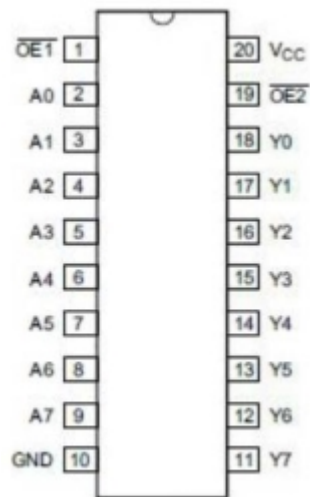


Figure 4. Logic diagram

Pin Configurations



DIP-20/SOP-20/TSSOP-20

Pin Description

| Pin No. | Pin Name | Description |
|---------|----------|--|
| 1 | OE | output enable input (active LOW) |
| 2 | Q0 | data output |
| 3 | D0 | data input |
| 4 | D1 | data input |
| 5 | Q1 | data output |
| 6 | Q2 | data output |
| 7 | D2 | data input |
| 8 | D3 | data input |
| 9 | Q3 | data output |
| 10 | GND | ground (0V) |
| 11 | CP | clock input (LOW-to-HIGH,edge-triggered) |
| 12 | Q4 | data output |
| 13 | D4 | data input |
| 14 | D5 | data input |
| 15 | Q5 | data output |
| 16 | Q6 | data output |
| 17 | D6 | data input |
| 18 | D7 | data input |
| 19 | Q7 | data output |
| 20 | Vcc | supply voltage |

Function Table

| Input | | | Output |
|-------|-----|----|--------|
| OE1 | OE2 | An | Yn |
| L | L | L | H |
| L | L | H | L |
| X | H | X | Z |
| H | X | X | Z |

Note:

H=HIGH voltage level;L=LOW voltage level;X=don't care;Z=high-impedance OFF-state.

Electrical Parameter

Absolute Maximum Ratings

(Voltages are referenced to GND(ground=0V), unless otherwise specified.)

| Parameter | Symbol | Conditions | Min | Max | Unit |
|-------------------------|------------------|--|------|------|------|
| supply voltage | VCC | | -0.5 | +7.0 | V |
| input clamping current | I _{IK} | V _i <-0.5V or V _i >V _{CC} +0.5V | | ±20 | mA |
| output clamping current | I _{OK} | V _o <-0.5V or V _o >V _{CC} +0.5V | | ±20 | mA |
| output current | I _o | -0.5V<V _o <V _{CC} +0.5V | | ±35 | mA |
| supply current | I _{CC} | | | 70 | mA |
| ground current | I _{GND} | | -70 | | mA |
| storage temperature | T _{stg} | | -65 | +150 | °C |
| total power dissipation | P _{tot} | | | 500 | mW |
| Soldering temperature | TL | 10s | DIP | 245 | °C |
| | | | SOP | 245 | |

Note:1. Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not ensured.

2. For DIP20 packages: above 70°C the value of P_{tot} derates linearly with 12mW/K.

3. For SOP20 packages: above 70°C the value of P_{tot} derates linearly with 8mW/K.

4. For TSSOP20 packages: above 60°C the value of P_{tot} derates linearly with 5.5mW/K.

Recommended Operating Conditions

| Parameter | Symbol | Conditions | Min | Typ | Max. | Unit |
|-------------------------------------|------------------|-----------------------|-----|------|-----------------|------|
| supply voltage | V _{CC} | | 2.0 | 5.0 | 6.0 | V |
| input voltage | V _i | | 0 | — | V _{CC} | V |
| output voltage | V _o | | 0 | | V _{CC} | V |
| input transition rise and fall rate | ΔtΔV | V _{CC} =2.0V | | | 625 | nsN |
| | | V _{CC} =4.5V | | 1.67 | 139 | nsN |
| | | V _{CC} =6.0V | | — | 83 | nsN |
| ambient temperature | T _{amb} | | -40 | | +105 | °C |

Electrical Characteristics

DC Characteristics 1

(Tamb=25°C, voltages are referenced to GND(ground=0V), unless otherwise specified.)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit | |
|---------------------------|--------|--|--------------------|------|------|------|---|
| HIGH-level input voltage | VH | Vcc=2.0V | 1.5 | 1.2 | | V | |
| | | Vcc=4.5V | 3.15 | 2.4 | | V | |
| | | Vcc=6.0V | 4.2 | 3.2 | | V | |
| LOW-level input voltage | VL | Vcc=2.0V | | 0.8 | 0.5 | V | |
| | | Vcc=4.5V | | 2.1 | 1.35 | V | |
| | | Vcc=6.0V | | 2.8 | 1.8 | V | |
| HIGH-level output voltage | Voh | Vi=Vh or VL | Io=-20uA;Vcc=2.0V | 1.9 | 2.0 | | V |
| | | | Io=-20uA;Vcc=4.5V | 4.4 | 4.5 | | V |
| | | | Io=-20uA;Vcc=6.0V | 5.9 | 6.0 | | V |
| | | | Io=-6.0mA;Vcc=4.5V | 3.98 | 4.32 | | V |
| | | | Io=-7.8mA;Vcc=6.0V | 5.48 | 5.81 | | V |
| LOWlevel output voltage | Vol | Vi=VH or VL | Io=20uA;Vcc=2.0V | | 0 | 0.1 | V |
| | | | Io=20uA;Vcc=4.5V | | 0 | 0.1 | V |
| | | | Io=20uA;Vcc=6.0V | | 0 | 0.1 | V |
| | | | Io=6.0mA;Vcc=4.5V | | 0.15 | 0.26 | V |
| | | | Io=7.8mA;Vcc=6.0V | | 0.16 | 0.26 | V |
| input leakage current | I | Vi=Vcc or GND;Vcc=6.0V | | | ±0.1 | uA | |
| OFF-state output current | Ioz | Vi=Vh or VL;Vcc=6.0V; Vo=Vcc or GND | | | ±0.5 | uA | |
| supply current | Icc | Vi=Vcc or GND;Io=0A;Vcc=6.0V | | | 8.0 | uA | |
| input capacitance | Ci | | | 3.5 | | pF | |

DC Characteristics 2

(Tamb=-40°C to +85°C, voltages are referenced to GND(ground=0V), unless otherwise specified.)

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit | |
|---------------------------|--------|--|--------------------|------|------|------|---|
| HIGH-level input voltage | ViH | Vcc=2.0V | 1.5 | | | V | |
| | | Vcc=4.5V | 3.15 | | | V | |
| | | Vcc=6.0V | 4.2 | | | V | |
| LOW-level input voltage | VL | Vcc=2.0V | | | 0.5 | V | |
| | | Vcc=4.5V | | | 1.35 | V | |
| | | Vcc=6.0V | | | 1.8 | V | |
| HIGH-level output voltage | VoH | Vi=Vh or VL | Io=-20uA;Vcc=2.0V | 1.9 | | | V |
| | | | Io=-20uA;Vcc=4.5V | 4.4 | | | V |
| | | | Io=-20uA;Vcc=6.0V | 5.9 | | | V |
| | | | Io=-6.0mA;Vcc=4.5V | 3.84 | | | V |
| | | | Io=-7.8mA;Vcc=6.0V | 5.34 | | | V |
| LOW-level output voltage | Vol | Vi=Vh or VL | Io=20uA;Vcc=2.0V | | | 0.1 | V |
| | | | Io=20uA;Vcc=4.5V | | | 0.1 | V |
| | | | Io=20uA;Vcc=6.0V | | | 0.1 | V |
| | | | Io=6.0mA;Vcc=4.5V | | | 0.33 | V |
| | | | Io=7.8mA;Vcc=6.0V | | | 0.33 | V |
| input leakage current | I | V=Vcc or GND;Vcc=6.0V | — | | ±1.0 | uA | |
| OFF-state output current | Ioz | Vi=Vih or VL;Vcc=6.0V Vo=Vcc or GND | | | ±5.0 | uA | |
| supply current | Icc | V=Vcc or GND;Io=0A;Vcc=6.0V | | | 80 | uA | |

DC Characteristics 3

(Tamb=40°C to +105°C, voltages are referenced to GND(ground=0V), unless otherwise specified.)

| Parameter | Symbol | Conditions | Min. | Typ. | Max | Unit | |
|---------------------------|-----------------|---|--|------|------|------|---|
| HIGH-level input voltage | V _H | V _{CC} =2.0V | 1.5 | | | V | |
| | | V _{CC} =4.5V | 3.15 | | | V | |
| | | V _{CC} =6.0V | 4.2 | | | V | |
| LOW-level input voltage | V _L | V _{CC} =2.0V | | | 0.5 | V | |
| | | V _{CC} =4.5V | | | 1.35 | V | |
| | | V _{CC} =6.0V | | | 1.8 | V | |
| HIGH-level output voltage | V _{OH} | V _i =V _{ih} or V _L | I _O =-20μA;V _{CC} =2.0V | 1.9 | | | V |
| | | | I _O =-20μA;V _{CC} =4.5V | 4.4 | | | V |
| | | | I _O =-20μA;V _{CC} =6.0V | 5.9 | | | V |
| | | | I _O =-6.0mA;V _{CC} =4.5V | 3.7 | | | V |
| | | | I _O =-7.8mA;V _{CC} =6.0V | 5.2 | | | V |
| LOW-level output voltage | V _{OL} | V _i =V _{ih} or V _L | I _O =20μA;V _{CC} =2.0V | | | 0.1 | V |
| | | | I _O =20μA;V _{CC} =4.5V | | | 0.1 | V |
| | | | I _O =20μA;V _{CC} =6.0V | | | 0.1 | V |
| | | | I _O =6.0mA;V _{CC} =4.5V | | | 0.4 | V |
| | | | I _O =7.8mA;V _{CC} =6.0V | | | 0.4 | V |
| input leakage current | I _I | V=V _{CC} or GND;V _{CC} =6.0V | | | ±1.0 | μA | |
| OFF-state output current | I _{OZ} | V _i =V _{ih} or V _L ;V _{CC} =6.0V; V _o =V _{CC} or GND | | | ±10 | μA | |
| supply current | I _{CC} | V=V _{CC} or GND;I _O =0A;V _{CC} =6.0V | — | | 160 | μA | |

AC Characteristics 1

(Tamb=25°C, GND=0V, CL=50pF, unless otherwise specified.)

| Parameter | Symbol | Conditions | Min. | Typ. | Max | Unit | |
|-------------------------------|--------|--------------------------|------------------|------|-----|------|----|
| An to Yn propagation delay | tpd | see Figure 6 | Vcc=2.0V | | 33 | 115 | ns |
| | | | Vcc=4.5V | | 12 | 23 | ns |
| | | | Vcc=5.0V;CL=15pF | | 10 | | ns |
| | | | Vcc=6.0V | | 10 | 20 | ns |
| OEn to Yn enable time | ten | see Figure 7 | Vcc=2.0V | | 55 | 160 | ns |
| | | | Vcc=4.5V | | 20 | 32 | ns |
| | | | Vcc=6.0V | | 16 | 27 | ns |
| OEn to Yn disable time | tis | see Figure 7 | Vcc=2.0V | | 61 | 160 | ns |
| | | | Vcc=4.5V | | 22 | 32 | ns |
| | | | Vcc=6.0V | | 18 | 27 | ns |
| transition time | tt | see Figure 6 | Vcc=2.0V | | 14 | 60 | ns |
| | | | Vcc=4.5V | | 5 | 12 | ns |
| | | | Vcc=6.0V | | 4 | 10 | ns |
| power dissipation capacitance | CPD | per buffer;Vi=GND to Vcc | | 37 | | pF | |

Note:

1. tpa is the same as tpLhand tpHL.
2. ten is the same as tpzt and tpzH.
3. tais is the same as tpuz and tpHz.
4. t is the same as trhand truh.
5. Cro is used to determine the dynamic power dissipation (Po in uW)

$P_o = C_{pp} \times V_{cc}^2 \times f_i \times N + Z(C \times V_{cc}^2 \times f_o)$ where:

fi=input frequency in MHz;

fo=output frequency in MHz;

CL=output load capacitance in pF;

Vcc=supply voltage in V;

N=number of inputs switching;

Z(Ct × Vcc² × fo)=sum of outputs.

AC Characteristics 2

(Tamb=-40°C to+85°C, GND=0V, CL=50pF, unless otherwise specified.)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit | |
|----------------------------|--------|--------------|----------|------|------|------|----|
| An to Yn propagation delay | tpd | see Figure 6 | Vcc=2.0V | | | 145 | ns |
| | | | Vcc=4.5V | | | 29 | ns |
| | | | Vcc=6.0V | | | 25 | NS |
| OEn to Yn enable time | ten | see Figure 7 | Vcc=2.0V | | | 200 | NS |
| | | | Vcc=4.5V | | | 40 | ns |
| | | | Vcc=6.0V | | | 34 | ns |
| OEn to Yn disable time | tis | see Figure 7 | Vcc=2.0V | | | 200 | NS |
| | | | Vcc=4.5V | | | 40 | NS |
| | | | Vcc=6.0V | | | 34 | ns |
| transition time | t | see Figure 6 | Vcc=2.0V | | | 75 | ns |
| | | | Vcc=4.5V | | | 15 | ns |
| | | | Vcc=6.0V | | | 13 | ns |

Note:

1. tra is the same as tpuhand tpHl
2. ten is the same as tpzt and tpzH.
3. tis is the same as tpuzandtpHz.
4. t is the same as trhland truh.

AC Characteristics 3

(Tamb=-40°C to +105°C, GND=0V, CL=50pF, unless otherwise specified.)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit | |
|----------------------------|--------|--------------|----------|------|------|------|----|
| An to Yn propagation delay | tpd | see Figure 6 | Vcc=2.0V | | | 175 | ns |
| | | | Vcc=4.5V | | | 35 | ns |
| | | | Vcc=6.0V | | | 30 | ns |
| OEn to Yn enable time | ten | see Figure 7 | Vcc=2.0V | | | 240 | ns |
| | | | Vcc=4.5V | | | 48 | ns |
| | | | Vcc=6.0V | | | 41 | ns |
| OEn to Yn disable time | tis | see Figure 7 | Vcc=2.0V | | | 240 | ns |
| | | | Vcc=4.5V | | | 48 | ns |
| | | | Vcc=6.0V | | | 41 | ns |
| transition time | t | see Figure 6 | Voc=2.0V | | | 90 | ns |
| | | | Vcc=4.5V | | | 18 | ns |
| | | | Vcc=6.0V | | | 15 | ns |

Note:

1. tu is the same as truhand tpHL.
2. ten is the same as tez and tpzh.
3. tas is the same as tpuzandtpHz.
4. t is the same as trhland truh.

Testing Circuit

AC Testing Circuit

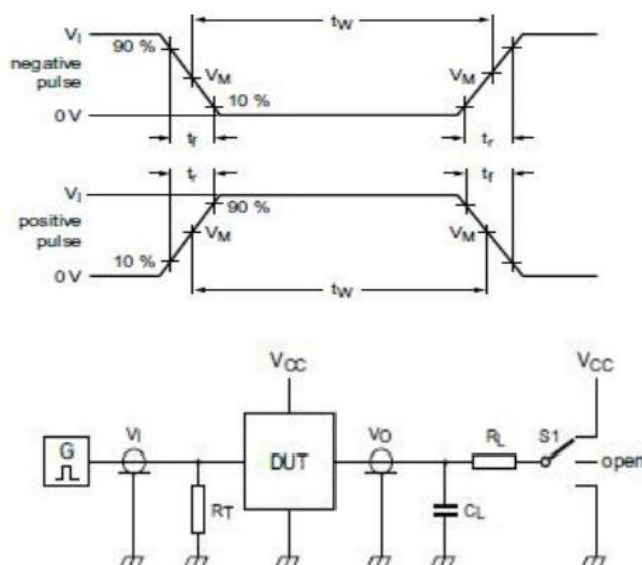


Figure 5. Test circuit for measuring switching times

Definitions for test circuit:

R_L =Load resistance.

C_L =Load capacitance including jig and probe capacitance.

R_T =Termination resistance should be equal to the output impedance Z_o of the pulse generator. S_1 =Test selection switch.

AC Testing Waveforms

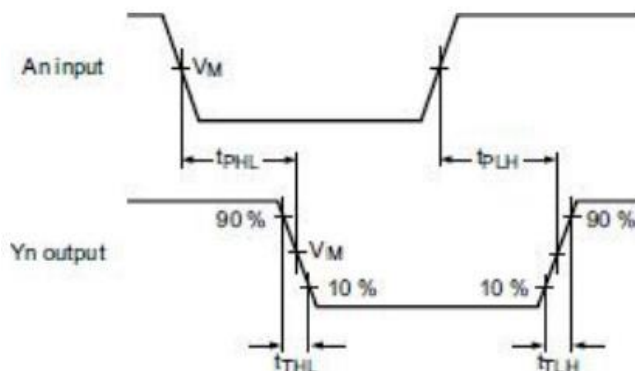
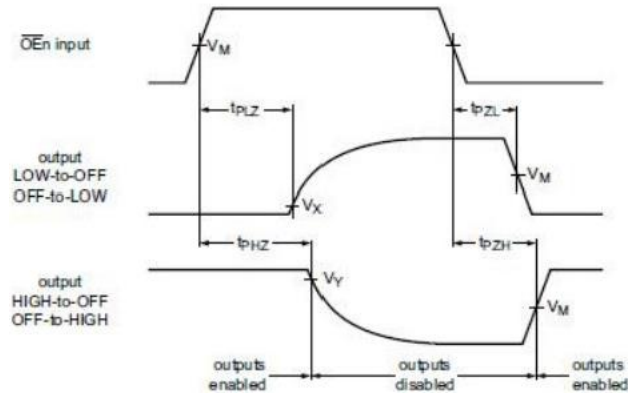


Figure 6. Input to output propagation delays


Figure 7.3-3-state enable and disable times
Measurement Points

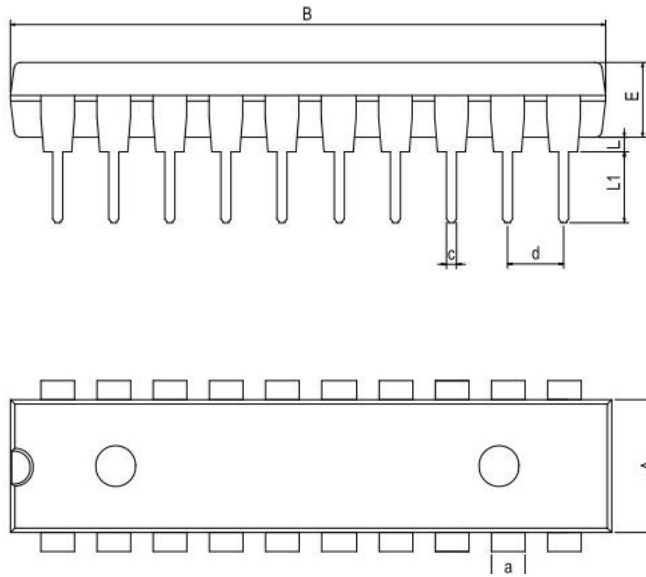
| Type | Input | Output | | |
|----------------|----------------|---------|---------|--------|
| | VM | VM | Vx | Vy |
| 74HC541 | 0.5×Vcc | 0.5×Vcc | 0.1×Vcc | 0.9×Vc |

Test Data

| Type | Input | | Load | | S1 position | | |
|----------------|----------------|------------|-------------------|------------|--------------|--------------|--------------|
| | v _i | tr, tr | CL | RL | tpHL tpLH | tezH tpHz | tpzI tpLz |
| 74HC541 | Vcc | 6ns | 15pF, 50pF | 1kΩ | open | GND | Vcc |

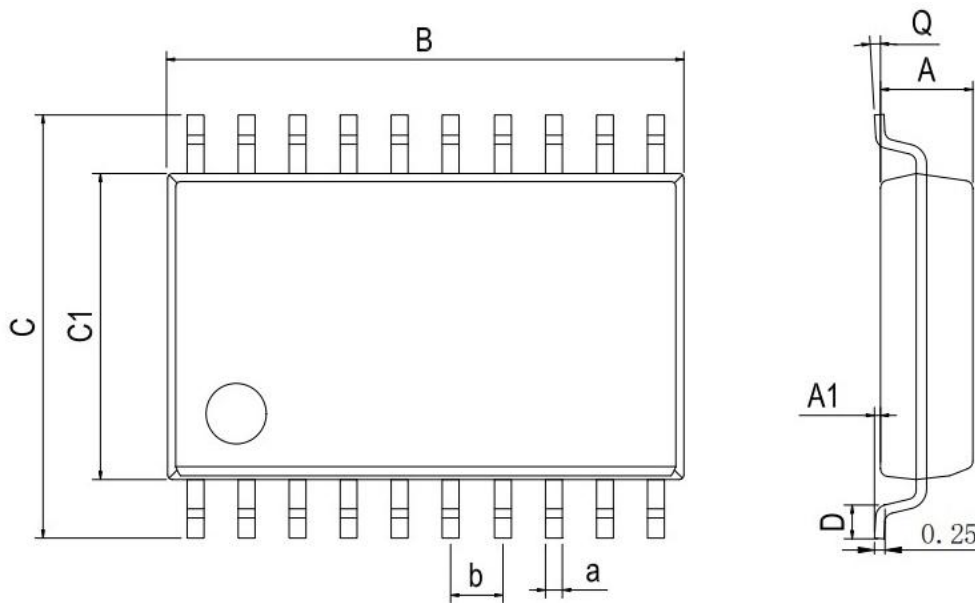
Physical Dimensions

DIP-20



| Dimensions In Millimeters(DIP-20) | | | | | | | | | | |
|-----------------------------------|------|-------|------|------|------|------|-------------|-------------|-------------|-----------------|
| Symbol: | A | B | D | D1 | E | L | L1 | a | C | d |
| Min: | 6.10 | 24.95 | 8.10 | 7.42 | 3.10 | 0.50 | 3.00 | 1.50 | 0.40 | 2.54 BSC |
| Max: | 6.68 | 26.55 | 10.9 | 7.82 | 3.55 | 0.70 | 3.60 | 1.55 | 0.50 | |

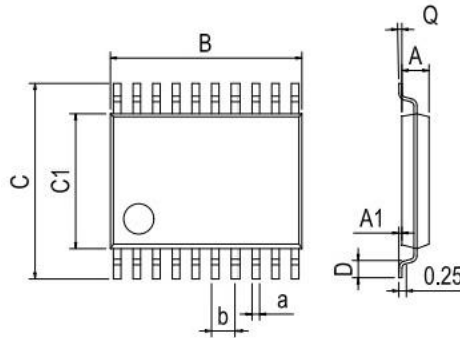
SOP-20



| Dimensions In Millimeters(SOP-20) | | | | | | | | | |
|-----------------------------------|------|------|-------|-------|-------------|-------------|-----------|-------------|-----------------|
| Symbol: | A | A1 | B | C | C1 | D | Q | a | b |
| Min: | 2.10 | 0.05 | 12.50 | 10.21 | 7.40 | 0.45 | 0° | 0.35 | 1.27 BSC |
| Max: | 2.50 | 0.25 | 13.00 | 10.61 | 7.60 | 1.25 | 8° | 0.45 | |

Physical Dimensions

TSSOP-20



| Dimensions In Millimeters(TSSOP-20) | | | | | | | | | |
|-------------------------------------|------|------|------|------|------|------|----|------|----------|
| Symbol: | A | A1 | B | C | C1 | D | Q | a | b |
| Min: | 0.85 | 0.05 | 6.40 | 6.20 | 4.30 | 0.40 | 0° | 0.20 | 0.65 BSC |
| Max: | 1.05 | 0.20 | 6.60 | 6.60 | 4.50 | 0.80 | 8° | 0.25 | |