DESCRIPTION

The AL541 is an 8-bit non-inverting buffer/line driver with 3-state outputs. The AL541 features two output enables ($\overline{OE}1$ and $\overline{OE}2$). A High on $\overline{OE}$ causes the associated outputs to assume a high-impedance OFF-state.

Inputs include clamp diodes that enable the use of current limiting resistors to interface inputs to voltages in excess of V_{CC}.

To ensure the high-impedance state during power up or power down, $\overline{OE}$ should be tied to V_{CC} through a pullup resistor, the minimum value of the resistor is determined by the current-sinking capability of the driver.

The AL541 is available in SOP20 and TSSOP20 Packages.

ORDERING INFORMATION

Package Type	Part Number	
SOP20 SPQ:1,500pcs/Reel	M20	AL541M20R
		AL541M20VR
TSSOP20 SPQ:4,000pcs/Reel	TMX20	AL541TMX20R
		AL541TMX20VR
Note	V: Halogen free Package R: Tape & Reel	
AiT provides all RoHS products		

H=High Voltage Level
L=Low Voltage Level
X=Don't Care
Z=High Impedance Off-State

FEATURES

- Power-Supply Range: 1.65V ~ 5.5V
- 3-State Outputs Drive Bus Lines
- Low Power Consumption: 5µA I_{CC} (Max).
- ±24mA Output Drive at 3V
- Low Input Current of 1µA (Max).
- Extended Temperature: -40°C to +125°C

APPLICATION

- Servers
- Smart Grids
- Network Switches
- Infotainment
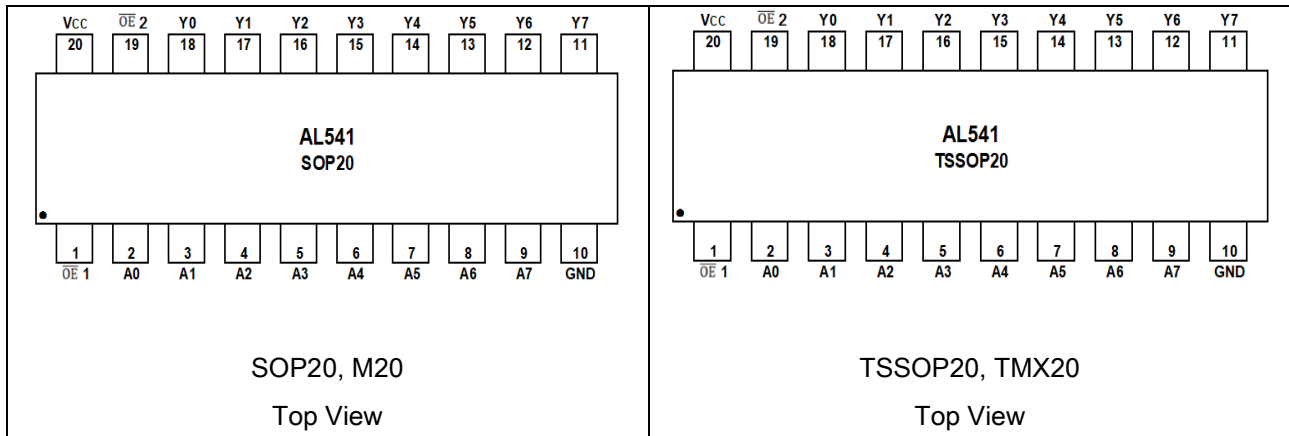- Surveillance Cameras

SIMPLIFIED BLOCK DIAGRAM

To Seven Other Channels
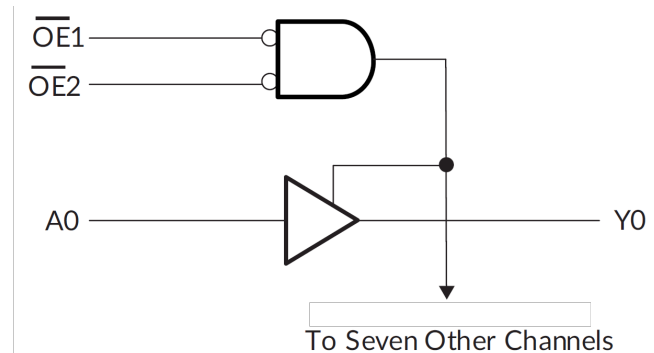
FUNCTION TABLE

Inputs			Output
$\overline{OE}1$	$\overline{OE}2$	A Port	Y Port
L	L	L	L
L	L	H	H
X	H	X	Z
H	X	X	Z

PIN DESCRIPTION

VCC	OE 2	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	
20	19	18	17	16	15	14	13	12	11	

AL541
SOP20

1	2	3	4	5	6	7	8	9	10
OE 1	A0	A1	A2	A3	A4	A5	A6	A7	GND

SOP20, M20

Top View

VCC	OE 2	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	
20	19	18	17	16	15	14	13	12	11	

AL541
TSSOP20

1	2	3	4	5	6	7	8	9	10
OE 1	A0	A1	A2	A3	A4	A5	A6	A7	GND

TSSOP20, TMX20

Top View

PIN#		Symbol	I/O	Function
SOP20	TSSOP20			
1	1	$\overline{OE}1$	I	Output Enable (Active Low). Pull $\overline{OE}1$ High to Place all Outputs in 3-State Mode.
2	2	A0	I	Date Input
3	3	A1	I	Date Input
4	4	A2	I	Date Input
5	5	A3	I	Date Input
6	6	A4	I	Date Input
7	7	A5	I	Date Input
8	8	A6	I	Date Input
9	9	A7	I	Date Input
10	10	GND	G	Gound
11	11	Y7	O	Date Output
12	12	Y6	O	Date Output
13	13	Y5	O	Date Output
14	14	Y4	O	Date Output
15	15	Y3	O	Date Output
16	16	Y2	O	Date Output
17	17	Y1	O	Date Output
18	18	Y0	O	Date Output
19	19	$\overline{OE}2$	I	Output Enable (Active Low). Pull $\overline{OE}2$ High to Place all Outputs in 3-State Mode.
20	20	V_{CC}	P	Supply Voltage.$1.65V \leq V_{CC} \leq 5.5V$

I = Input, O=Output, P=Power

ABSOLUTE MAXIMUM RATINGS

over operating free-air temperature range (unless otherwise noted)

V_{CC}, Supply Voltage Range		-0.5V ~ + 6.5V
V_I, Input Voltage Range [1]	A Port	-0.5V ~ + 6.5V
	Control Inputs	-0.5V ~ + 6.5V
V_O, Voltage Range Applied to any Output in the High-Impedance or Power-Off State [1]	Y Port	-0.5V ~ + 6.5V
V_O, Voltage Range Applied to any Output in the High or Low State [2] [3]	Y Port	-0.5V ~ + V_{CCA} +0.5V
I_{IK}, Input Clamp Current	V_I<0	-50mA
I_{OK}, Output Clamp Current	V_O<0	-50mA
I_O, Continuous Output Current		±50mA
I_O, Continuous Current through V_{CCA}, V_{CCB} or GND		±100mA
θ_{JA}, Package thermal impedance	SOP20	40℃/W
	TSSOP20	40℃/W
T_J, Junction Temperature [4]		-40℃ ~ +150℃
T_{STG}, Storage Temperature		-65℃ ~ +150℃

Stresses above may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated in the Electrical Characteristics are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

(1) The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.

(2) The value of V_{CC} is provided in the Recommended Operating Conditions table.

(3) The package thermal impedance is calculated in accordance with JESD-51.

(4) The maximum power dissipation is a function of $T_{J(MAX)}$, $R_{\theta JA}$, and T_A.

The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(MAX)} - T_A) / R_{\theta JA}$. All numbers apply for packages soldered directly onto a PCB.

ESD RATINGS

Parameter	Symbol	Min	Unit
Human-Body Model (HBM), MIL-STD-883K METHOD 3015.9	$V_{(ESD)}$ Electrostatic discharge	±2000	V
Charged-Device Model (CDM), ANSI/ESDA/JEDEC JS-002-2018		±1000	
Machine Model (MM), JESD22-A115C (2010)		±200	

RECOMMENDED OPERATING CONFITIONS

V_{CC} is the supply voltage associated with the input port and output port.[1][2]

Parameter	Symbol	Conditions		Min	Max	Unit
Supply Voltage	V_{CC}	-		1.65	5.5	V
High-Level Input Voltage	V_{IH}	Inputs[3]	V_{CC} = 1.65V ~ 1.95V	V_{CC} x 0.65	-	V
			V_{CC} = 2.3V ~ 2.7V	1.7	-	
			V_{CC} = 3V ~ 3.6V	2	-	
			V_{CC} = 4.5V ~ 5.5V	V_{CC} x 0.7	-	
Low-Level Input Voltage	V_{IL}	Inputs[3]	V_{CC} = 1.65V ~1.95V	-	V_{CC} x 0.35	V
			V_{CC} = 2.3V ~2.7V	-	0.7	
			V_{CC} = 3V ~ 3.6V	-	0.8	
			V_{CC} = 4.5V ~ 5.5V	-	V_{CC}x0.3	
Input Voltage	V_I	-		0	5.50	V
Output Voltage	V_O	-		0	V_{CC}	V
High-Level Output Current	I_{OH}	V_{CC} = 1.65V ~ 1.95V		-	-4	mA
		V_{CC} = 2.3V ~ 2.7V		-	-8	
		V_{CC} = 3V ~ 3.6V		-	-24	
		V_{CC} = 4.5V ~ 5.5V		-	-32	
Low-Level Output Current	I_{OL}	V_{CC} = 1.65V ~ 1.95V		-	4	mA
		V_{CC} = 2.3V ~ 2.7V		-	8	
		V_{CC} = 3V ~ 3.6V		-	24	
		V_{CC} = 4.5V ~ 5.5V		-	32	
Input Transition Rise or Fall Rate	$\Delta t/\Delta v$	Date Inputs	V_{CC} = 1.65V ~ 1.95V		20	ns/V
			V_{CC} = 2.3V ~ 2.7V	-	20	
			V_{CC} = 3V ~ 3.6V	-	10	
			V_{CC} = 4.5V ~ 5.5V	-	5	
Operating Free-Air Temperature	T_A	-		-40	125	°C

(1) All unused or driven (floating) data inputs (I/Os) of the device must be held at logic HIGH or LOW (preferably V_{CC} or GND) to ensure proper device operation and minimize power.

(2) All unused control inputs must be held at V_{CC} or GND to ensure proper device operation and minimize power consumption.

(3) For V_{CC} values not specified in the data sheet, V_{IH} min = V_{CC} × 0.7 V, V_{IL} max = V_{CC} × 0.3V.

ELECTRICAL CHARACTERISTICS

T_A = +25°C, unless otherwise noted)

Symbol	Conditions		Min	Typ.	Max	Unit
V_{OH}	I_{OH} = -100µA, $V_I = V_{IH}$, V_{CC} = 1.65V~4.5V	-40°C ~ +125°C	V_{CC}~0.1	-	-	V
	I_{OH} = -4mA, $V_I = V_{IH}$, V_{CC} = 1.65V		1.2	-	-	
	I_{OH}= -8mA, $V_I = V_{IH}$, V_{CC} = 2.3V		1.9	-	-	
	I_{OH} = -24mA, $V_I = V_{IH}$, V_{CC} = 3V		2.2	-	-	
	I_{OH} = -32mA, $V_I = V_{IH}$, V_{CC} = 4.5V		3.6	-	-	
V_{OL}	I_{OL} = 100µA, $V_I = V_{IL}$, V_{CC} = 1.65V~4.5V	-40°C ~ +125°C	-	-	0.1	V
	I_{OL}= 4mA, $V_I = V_{IL}$, V_{CC} = 1.65V				0.45	
	I_{OL} = 8mA, $V_I = V_{IL}$, V_{CC} = 2.3V				0.4	
	I_{OL} = 24mA, $V_I = V_{IL}$, V_{CC} = 3V				0.85	
	I_{OL} = 32mA, $V_I = V_{IL}$, V_{CC} = 4.5V				0.89	
I_I	V_I = 5.5V or GND, V_{CC} = 5.5V	+25°C	-	-	±1	µA
I_{off}	V_I or V_O = 0 to 5.5V, V_{CC} = 0V	+25°C	-	-	±1	µA
		-40°C ~ +125°C	-	-	±2	
I_{OZ}	$V_O = V_{CC}$ or GND, $\overline{OE}$ = V_{IH} V_{CC} = 1.65V~5.5V	+25°C	-	-	±1	µA
		-40°C ~ +125°C	-	-	±2	
I_{CC} V_{cc} supply current	$V_I = V_{CC}$ or GND, I_O = 0, V_{CC} = 1.65V~5.5V	+25°C	-	-	1	µA
		-40°C ~ +125°C	-	-	5	
ΔI_{CC}	One A port at V_{CC} – 0.6V, Y port = open, V_{CC} = 3V~5.5V	-40°C ~ +125°C	-	-	50	µA
C_I	$V_I = V_{CC}$ or GND, V_{CC} = 3.3V	+25°C	-	3.3	-	pF
C_O	$V_I = V_{CC}$ or GND, V_{CC} = 3.3V	+25°C	-	5	-	pF

SWITCHING CHARACTERISTICS

Symbol	From (Input)	To (Output)	V_{CC}=1.80V ±0.15V		V_{CC}=2.50V ±0.2V[1]		V_{CC}=3.30V ±0.3V[1]		V_{CC}=5V ±0.5V[1]		Unit
			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
t_{PLH} t_{PHL}	An	Yn	4.8	18	2.1	8.1	1.8	6.3	1.5	4.8	ns
t_{PHZ} t_{PLZ}	$\overline{OE}$	Yn	4.8	20.7	2.3	8.7	2.1	8.5	1.3	6.2	ns
t_{PZH} t_{PZL}	$\overline{OE}$	Yn	4.1	25.1	2.4	13.2	1.7	10.1	1.6	7.7	ns

OPERATING CHARACTERISTICS

Parameter	Symbol	Conditions	V_{CC}=1.80V Typ.	V_{CC}=2.50V Typ.	V_{CC}=3.30V Typ.	V_{CC}=5V Typ.	Unit
Outputs Enabled	C_{pd}	C_L=0, f=10MHz, tr=tf=1ns	8	9	11	13	pF
Outputs Disabled			1	1	1.5	2	

Power dissipation capacitance per transceiver

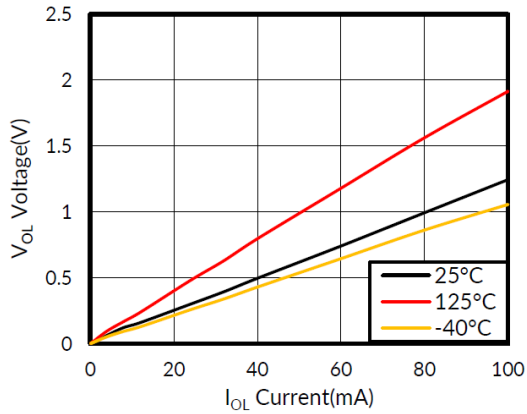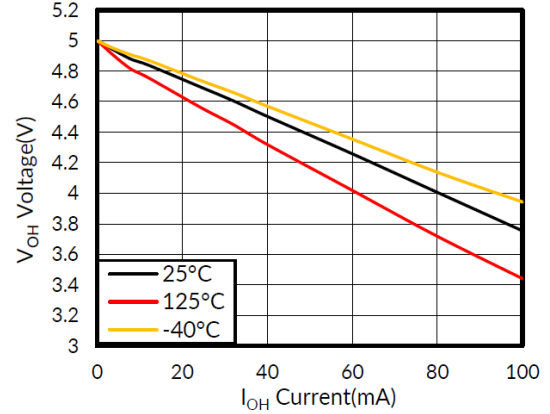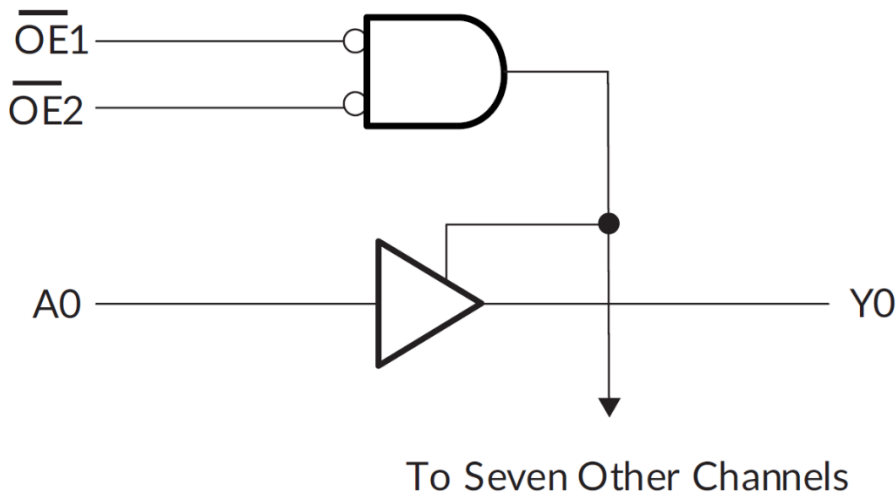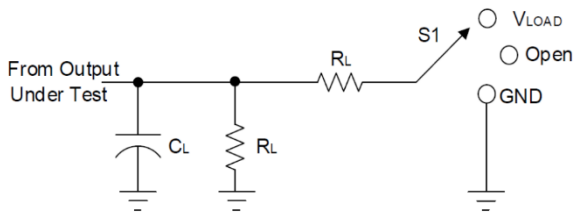## TYPICAL CHARACTERISTICS

Fig 1. Voltage vs. Current

Fig 2. Voltage vs. Current

BLOCK DIAGRAM

To Seven Other Channels

PARAMETER MEASUREMENT INFORMATION

TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PIZ}/t_{PZL}	V_{LOAD}
t_{PHZ}/t_{PZH}	GND

| V_{CC}	VI	VM	C_L	R_L	V_{TP}
1.8V±0.15V	V_{CC}	$V_{CC}/2$	15pF	2kΩ	0.15V
2.5V±0.2V	V_{CC}	$V_{CC}/2$	15pF	2kΩ	0.15V
3.3V±0.3V	2.7V	1.5V	15pF	2kΩ	0.3V
5V±0.5V	2.7V	$V_{CC}/2$	15pF	2kΩ	0.3V
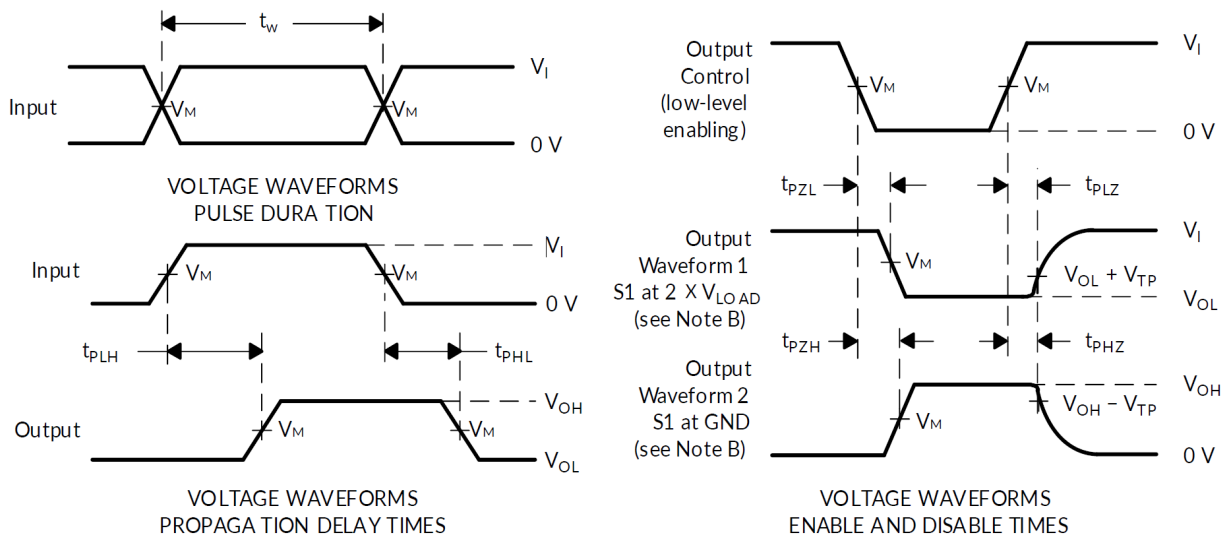
Fig 1. Load Circuit and Voltage Waveforms

(A) C_L includes probe and jig capacitance.

(B) Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control.
   Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.

(C) All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Z_O = 50 Ω.

(D) The outputs are measured one at a time, with one transition per measurement.

(E) All parameters and waveforms are not applicable to all devices.

PACKAGE INFORMATION

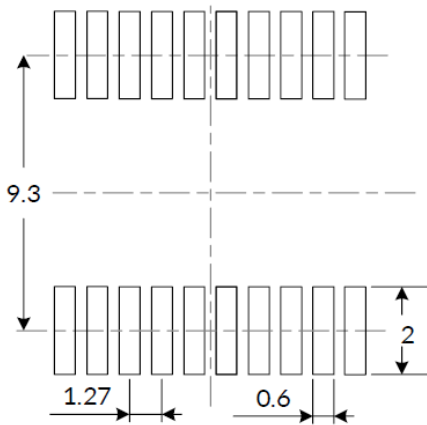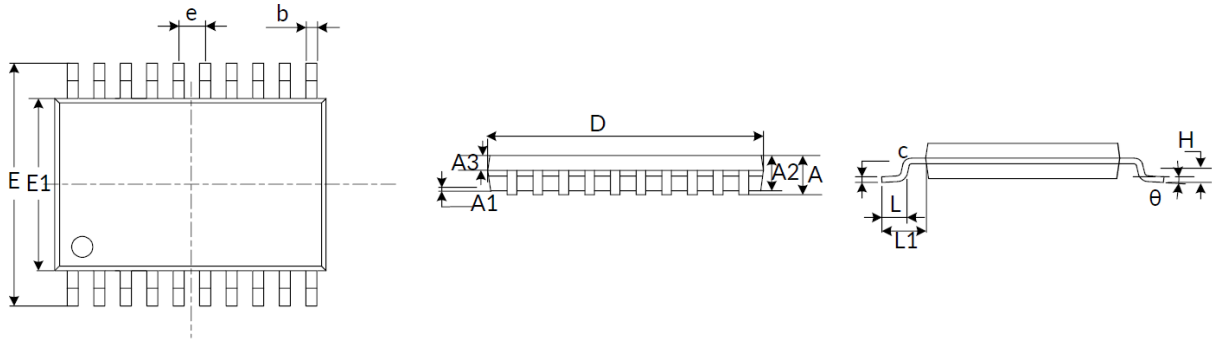Dimension in TSSOP20 Package (Unit: mm)
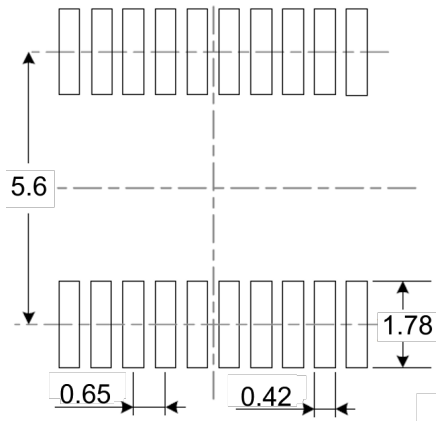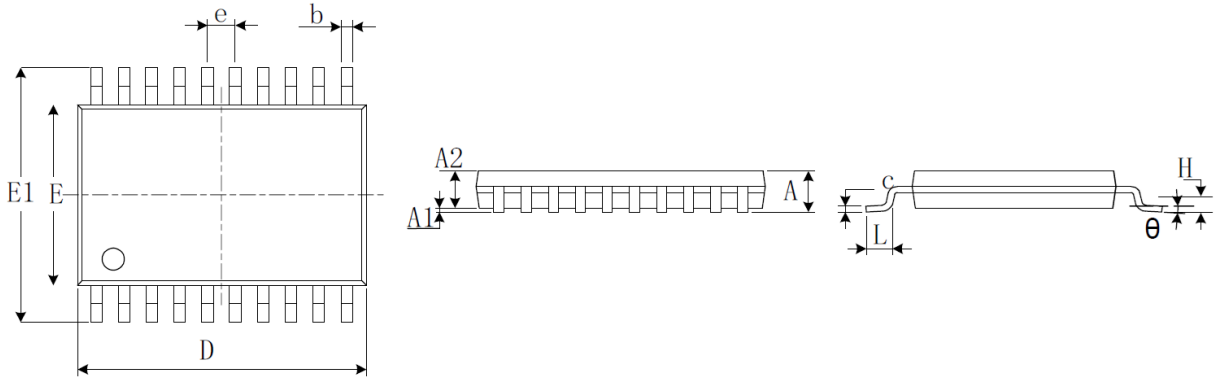
RECOMMENDED LAND PATTERN

Symbol	Millimeters	
	Min	**Max**
A	-	1.200
A1	0.050	0.150
A2	0.800	1.050
b	0.200	0.290
c	0.130	0.170
D	6.400	6.600
E	4.300	4.500
E1	6.200	6.600
e	0.650 BSC	
L	0.450	0.750
H	0.250 TYP.	
θ	0°	8°

Dimension in SOP20 Package (Unit: mm)

RECOMMENDED LAND PATTERN

Symbol	Millimeters	
	Min	**Max**
A	-	2.650
A1	0.100	0.300
A2	0.250	2.350
A3	0.970	1.070
b	0.390	0.470
c	0.250	0.290
D	12.700	12.900
E	10.100	10.500
E1	7.400	7.600
e	1.270 BSC.	
L	0.700	1.000
H	0.250 TYP.	
θ	0°	8°
L	1.400 REF.	

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