ETS0108 - 8 Bit Level Bidirectional Translator for Open-Drain and Push-Pull Applications

General Description

The ETS0108 is an 8-bit bidirectional level translator in which the input and output ports are switched automatically without direction control. Each channel can be mixed and matched with different output types (open-drain or push-pull) and mixed data flows (transmit or receive) without intervention from the host. All of the I/O ports are designed to track two different power supply rails, V_{VCCA} and V_{VCCB} respectively. The VCCB pin accepts any supply voltage from 2.3V to 5.5V while the VCCA pin accepts any supply voltage from 1.65V to 3.6V such that V_{VCCA} is less than or equal to V_{VCCB}. This tracking allows for low-voltage bidirectional translation between any of the 1.8V, 2.5V, 3.3V, and 5V voltage nodes.

The ETS0108 has enable pin (OE), which can be used to disable both I/O ports by putting them in high-impedance state. The OE signal is referenced to the V_{VCCA} supply.

Features

- No Direction-control Signal Required
- Maximum Data Rates:
  --24Mbps (Push Pull)
  --2Mbps (Open Drain)
- 1.65V to 3.6V on A Port and 2.3V to 5.5V on B Port ($V_{VCCA} \le V_{VCCB}$)
- No Power-supply Sequencing Required, V_{VCCA} or V_{VCCB} can be Ramped First
- Latch-Up Performance Exceeds 100mA Per JEDEC JESD78F
- A Port ESD Protection:
  -- 2000V Human-Body Model (JEDEC JS-001)
  -- 1000V Charged-Device Model (JEDEC JS-002)
- B Port ESD Protection:
  -- 8000V Human-Body Model (JEDEC JS-001)
  -- 1000V Charged-Device Model (JEDEC JS-002)
- Part No. and Package Information

Part No.	Package	MSL
ETS0108V	TSSOP20 (4.4mm × 6.5mm)	Level 3

Pin Configuration

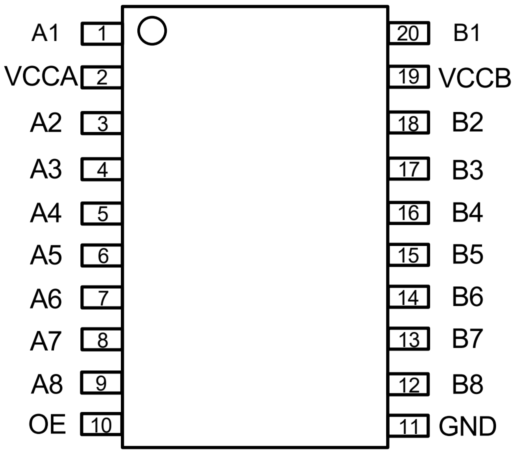


Figure1. Pin Configuration

Pin Function

Pin No.	Pin Name	Description
1, 3~9	A1, A2~8	Input/Output A1~A8. Referenced to V_{VCCA}.
11	GND	Ground
2	VCCA	A port Supply Voltage. 1.65V ≤V_{VCCA} ≤ 3.6V and V_{VCCA} ≤V_{VCCB}
10	OE	3-state Output-mode Enable. Pull OE low to place all outputs in 3-state Mode. Referenced to V_{VCCA}.
19	VCCB	B port Supply Voltage. 2.3V ≤ V_{VCCB} ≤ 5.5V
12~18, 20	B2~8, B1	Input/Output B1~B8. Referenced to V_{VCCB}.

Function Table

Control OE [1]	Outputs
Low Logic Level	3-State
High Logic Level	Normal Operation

Note1: If the OE pin is driven low, the ETS0108 is disabled and the A1~A8, B1~B8 pins (including dynamic drivers) are forced into 3-state.

Block Diagram

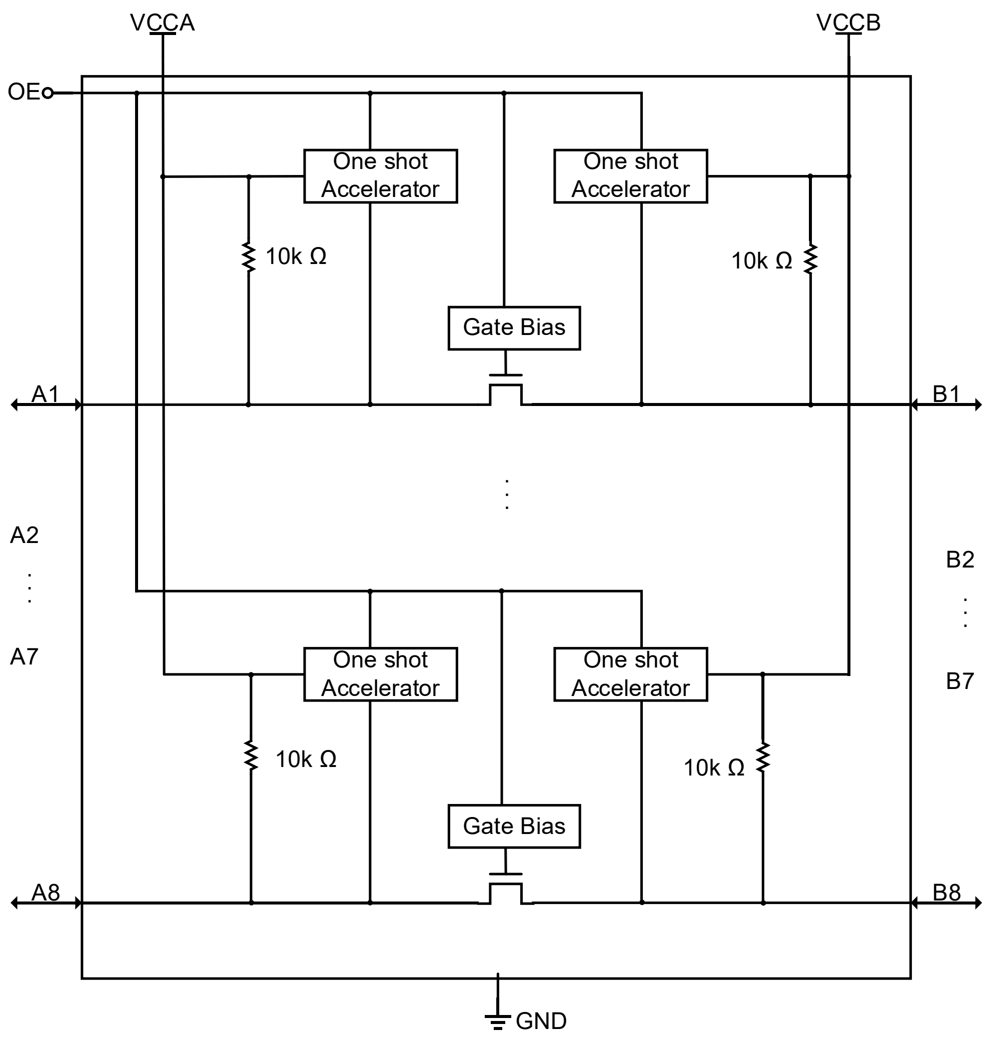


Figure2. Simplified Functional Diagram

Functional Description

Architecture

The ETS0108 architecture does not require a direction-control signal in order to control the direction of data flow from A to B or from B to A.

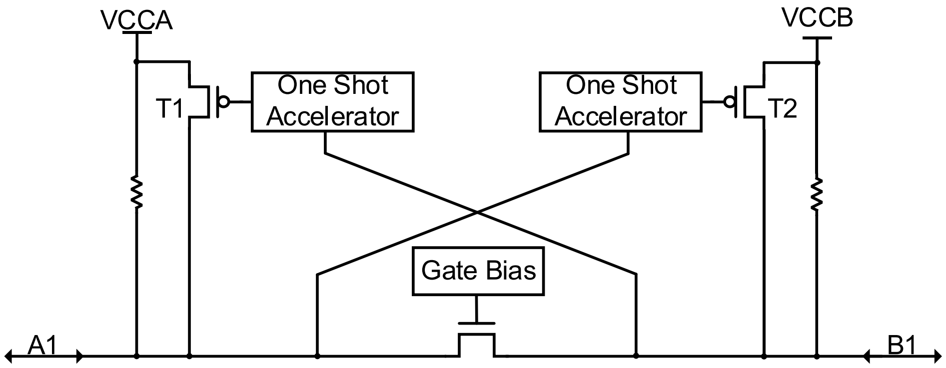


Figure3. Architecture of an ETS0104 Cell

Each A-port I/O has an internal 10kΩ pullup resistor to VCCA, and each B-port I/O has an internal 10kΩ pullup resistor to VCCB. The output one-shots detect rising edges on the A or B ports. During a rising edge, the one-shot turns on the PMOS transistors (T1, T2) for a short duration which speeds up the Low-to-High transition.

Input Driver Requirements

The fall time ($t_{FALL(A)}$, $t_{FALL(B)}$) of a signal depends on the output impedance of the external device driving the data I/Os of the ETS0108 device. Similarly, the t_{PHL} and maximum data rates also depend on the output impedance of the external driver. The values for $t_{FALL(A)}$, $t_{FALL(B)}$, t_{PHL}, and maximum data rates in the data sheet assume that the output impedance of the external driver is less than 50 Ω.

Power-Up / Power-Down Sequencing

ETS0108 is a bi-directional level shift. So translators offer an advantage in that either VCC may be powered up first. During operation, ensure that $V_{VCCA} \le V_{VCCA}$ at all times. During power-up sequencing, $V_{VCCA} \ge V_{VCCB}$ does not damage the device, so any power supply can be ramped up first.

Note: Alternatively, the OE pin can be hardwired to VCCA to save GPIO pins. If OE is hardwired to VCCA, either VCC can be powered up or down first.

Enable and Disable

The ETS0108 device has an OE input that disables the device by setting OE low, which places all I/Os in the high-impedance state. The disable time (tdis) indicates the delay between the time when the OE pin goes low and when the outputs actually enter the high-impedance state. The enable time (ten) indicates the amount of time the user must allow for the one-shot circuitry to become operational after the OE pin is taken high.

Pull Up and Pull-Down Resistors on I/O Lines

Each A-port I/O has an internal 10kΩ pullup resistor to VCCA, and each B-port I/O has an internal 10kΩ pullup resistor to VCCB. If a smaller value of pullup resistor is required, an external resistor must be added from the I/O to VCCA or VCCB (in parallel with the internal 10 kΩ resistors).

Application Circuits

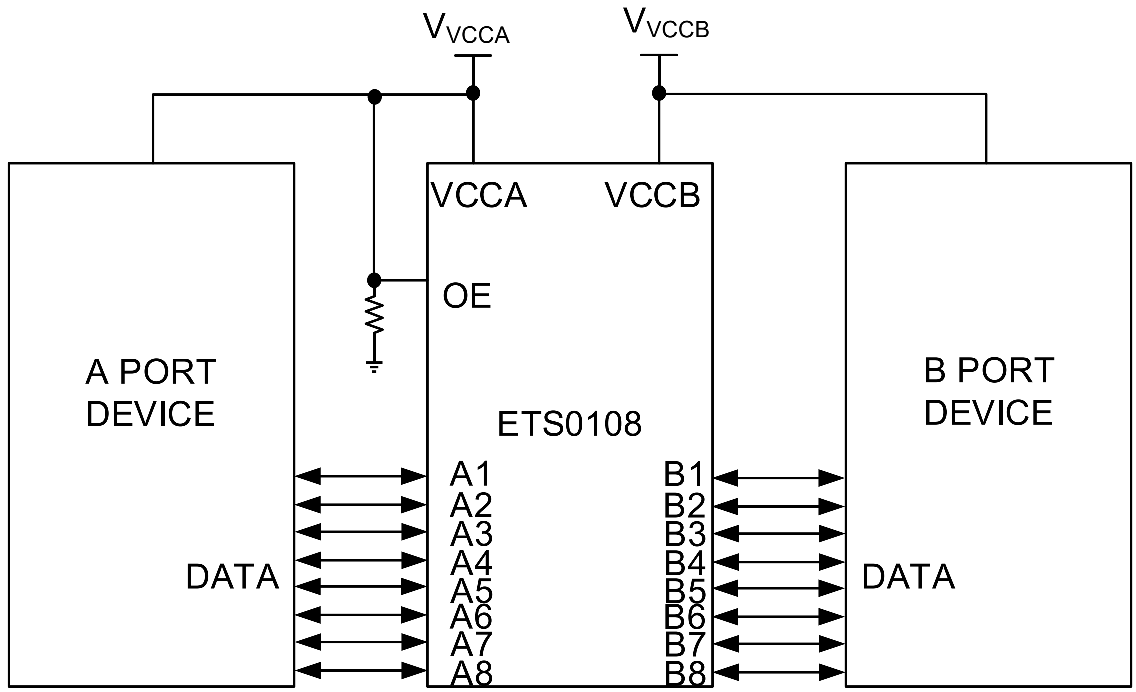


Figure4. Application Circuit [2]

Note2: This electric circuit only supplies for reference.

Application Information

The ETS0108 device can be used in level-translation applications for interfacing devices or systems operating at different interface voltages with one another. The ETS0108 device is optimal for use in applications where an open-drain driver is connected to the data I/Os. The ETS0108 device can also be used in applications where a push-pull driver is connected to the data I/Os.

Absolute Maximum Ratings

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

Symbol	Parameter		Min	Max	Unit
V_{VCCA}	Supply Voltage for VCCA, VCCB Pin		-0.5	4.6	V
V_{VCCB}			-0.5	6.5	
V_{IN}	DC Input Voltage	A Port	-0.5	4.6	V
		B Port	-0.5	6.5	
		Control Input (OE)	-0.5	4.6	
V_O	Output Voltage	An Outputs 3-State	-0.5	4.6	V
		Bn Outputs 3-State	-0.5	6.5	
		An Outputs Active	-0.5	V_{VCCA} + 0.5	
		Bn Outputs Active	-0.5	V_{VCCB} + 0.5	
I_{IK}	DC Input Clamp Current	At V_{IN} < 0V		-50	mA
I_{OK}	DC Output Clamp Current	At V_O < 0V		-50	mA
I_O	Continuous output current, IO			±50	mA
I_{VCC}	Continuous Current Through each VCCA, VCCB, or GND			±100	mA
T_{STG}	Storage Temperature Range		-65	+150	°C
V_{ESD}	Electrostatic Discharge Capability	Human Body Model, An [(3)]		±2	kV
		Human Body Model, Bn [(3)]		±8	
		Charged Device Mode [(4)]		±1	
I_{LU}	Latch Up Current Maximum Rating [(5)]			100	mA

Note3: HBM tested per JEDEC JS-001;

Note4: CDM tested per JEDEC JS-002;

Note5: Latch Up Current Maximum Rating tested per JEDEC JESD78F;

Recommended Operating Conditions

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

Symbol	Parameter		Min	Max	Unit
V_{VCCA}	Operating Power Supply		1.65	3.6	V
V_{VCCB}			2.3	5.5	
V_{IN}	Input Voltage (6)	A-Port	0	5.5	V
		B-Port	0	5.5	
		Control Input (OE)	0	V_{VCCA}	
T_A	Free Air Operating Temperature		-40	+85	°C

Note6: All unused inputs and I/O pins must be held at V_{VCCI} or GND. V_{VCCI} is the V_{VCC} associated with the input side.

DC Electrical Characteristics (7)

T_A = -40ºC~85ºC, (unless otherwise noted, all typical values are at T_A = 25°C.)

Symbol	Parameter	Conditions	V_{VCCA}(V)	V_{VCCB}(V)	Min	Typ	Max	Unit
V_{IHA}	High Level Input Voltage, A		1.65~1.95	2.3~5.5	V_{VCCA} - 0.2			V
			2.3~3.6		V_{VCCA} - 0.4			V
V_{IHB}	High Level Input Voltage, B		1.65~3.6	2.3~5.5	V_{VCCB} - 0.4			V
$V_{IH(OE)}$	High Level Input Voltage, OE		1.65~3.6	2.3~5.5	V_{VCCA} * 0.65			V
V_{ILA}	Low Level Input Voltage, A		1.65~3.6	2.3~5.5			0.15	V
V_{ILB}	Low Level Input Voltage, B		1.65~3.6	2.3~5.5			0.15	V
$V_{IL(OE)}$	Low Level Input Voltage, OE		1.65~3.6	2.3~5.5			V_{VCCA} * 0.35	V
V_{OHA}	High Level Output Voltage, A	I_{OH} = -20uA, $V_{I(Bx)} \geq V_{VCCB}$ - 0.4V	1.65~3.6	2.3~5.5	V_{VCCA} * 0.75			V
V_{OHB}	High Level Output Voltage, B	I_{OH} = -20uA, $V_{I(Ax)} \geq V_{VCCA}$ - 0.2V	1.65~5.5	2.3~5.5	V_{VCCB} * 0.75			V
V_{OLA}	Low Level Output Voltage, A	I_{OL} = 1mA, $V_{I(Bx)} \leq 0.15$V	1.65~5.5	2.3~5.5			0.4	V
V_{OLB}	Low Level Output Voltage, B	I_{OL} = 1mA, $V_{I(Ax)} \leq 0.15$V	1.65~5.5	2.3~5.5			0.4	V

DC Electrical Characteristics (Continued) [7]

T_A = -40ºC~85ºC, (unless otherwise noted, all typical values are at T_A = 25°C.)

Symbol	Parameter	Conditions	V_{VCCA}(V)	V_{VCCB}(V)	Min	Typ	Max	Unit
$I_{I(OE)}$	Input Leakage Current, OE	OE = V_{IL}	1.65~3.6	2.3~5.5		±1.0	±2.0	uA
I_{OZ}	Off-state Output Current, A or B port	OE = V_{IL}	1.65~3.6	2.3~5.5		±1.0	±3.0	uA
$I_{VCCA/B}$	Quiescent Supply Current, A Port plus B Port Supply Current	V_I = V_O = Floating, I_O = 0	1.65~V_{VCCB}	2.3~5.5			25	uA
I_{CCA}	Quiescent Supply Current, A Port	V_I = V_O = Floating, I_O = 0	1.65~V_{VCCB}	2.3~5.5			5	uA
			3.6	0			2.2	
			0	5.5			-1	
I_{CCB}	Quiescent Supply Current	V_I = V_O = Floating, I_O = 0	1.65~V_{VCCB}	2.3~5.5			21	uA
			3.6	0			-2.0	
			0	5.5			5	
C_{IN}	Input Capacitance Control Pin (OE)	V_{VCCA} = V_{VCCB} = GND	3.3	3.3		4	8	pF
$C_{I/O}$	Input/Output Capacitance, An, Bn		3.3	3.3		5	9	pF

Note7: V_{VCCA} must be less than or equal to V_{VCCB}, and V_{VCCA} must not exceed 3.6 V.

Dynamic Output Electrical Characteristics

Output Rise/Fall Time, V_{VCCA} = 1.8V ± 0.15V[8]

C_L = 15pF, R_L = 1MΩ, and T_A = -40°C to +85°C.

<table>
<tr><th>VCCA</th><th>Parameter</th><th colspan="2">Test Condition</th><th>Min</th><th>Typ</th><th>Max</th><th>Unit</th></tr>
<tr><td rowspan="6">$t_{RISE(A)}$</td><td rowspan="6">Output Rise Time: A Port</td><td rowspan="3">Push-pull</td><td>V_{VCCB} = 2.5V ± 0.2V</td><td></td><td>6.6</td><td>13.2</td><td rowspan="6">ns</td></tr>
<tr><td>V_{VCCB} = 3.3V ± 0.3V</td><td></td><td>7</td><td>14</td></tr>
<tr><td>V_{VCCB} = 5.0V ± 0.3V</td><td></td><td>5.4</td><td>10.8</td></tr>
<tr><td rowspan="3">Open-drain</td><td>V_{VCCB} = 2.5V ± 0.2V</td><td></td><td>116</td><td>232</td></tr>
<tr><td>V_{VCCB} = 3.3V ± 0.3V</td><td></td><td>94</td><td>188</td></tr>
<tr><td>V_{VCCB} = 5.0V ± 0.3V</td><td></td><td>68</td><td>136</td></tr>
<tr><td rowspan="6">$t_{RISE(B)}$</td><td rowspan="6">Output Rise Time: B Port</td><td rowspan="3">Push-pull</td><td>V_{VCCB} = 2.5V ± 0.2V</td><td></td><td>6.6</td><td>13.2</td><td rowspan="6">ns</td></tr>
<tr><td>V_{VCCB} = 3.3V ± 0.3V</td><td></td><td>5.4</td><td>10.8</td></tr>
<tr><td>V_{VCCB} = 5.0V ± 0.3V</td><td></td><td>9.5</td><td>19</td></tr>
<tr><td rowspan="3">Open-drain</td><td>V_{VCCB} = 2.5V ± 0.2V</td><td></td><td>102</td><td>204</td></tr>
<tr><td>V_{VCCB} = 3.3V ± 0.3V</td><td></td><td>72</td><td>144</td></tr>
<tr><td>V_{VCCB} = 5.0V ± 0.3V</td><td></td><td>38.6</td><td>77</td></tr>
<tr><td rowspan="6">$t_{FALL(A)}$</td><td rowspan="6">Output Fall Time: A Port</td><td rowspan="3">Push-pull</td><td>V_{VCCB} = 2.5V ± 0.2V</td><td></td><td>6.4</td><td>12.8</td><td rowspan="6">ns</td></tr>
<tr><td>V_{VCCB} = 3.3V ± 0.3V</td><td></td><td>5.2</td><td>10.4</td></tr>
<tr><td>V_{VCCB} = 5.0V ± 0.3V</td><td></td><td>5.8</td><td>11.6</td></tr>
<tr><td rowspan="3">Open-drain</td><td>V_{VCCB} = 2.5V ± 0.2V</td><td></td><td>7.1</td><td>14.2</td></tr>
<tr><td>V_{VCCB} = 3.3V ± 0.3V</td><td></td><td>7.1</td><td>14.2</td></tr>
<tr><td>V_{VCCB} = 5.0V ± 0.3V</td><td></td><td>7.5</td><td>15</td></tr>
<tr><td rowspan="6">$t_{FALL(B)}$</td><td rowspan="6">Output Fall Time: B Port</td><td rowspan="3">Push-pull</td><td>V_{VCCB} = 2.5V ± 0.2V</td><td></td><td>5.2</td><td>10.4</td><td rowspan="6">ns</td></tr>
<tr><td>V_{VCCB} = 3.3V ± 0.3V</td><td></td><td>5.6</td><td>11.2</td></tr>
<tr><td>V_{VCCB} = 5.0V ± 0.3V</td><td></td><td>8.8</td><td>17.6</td></tr>
<tr><td rowspan="3">Open-drain</td><td>V_{VCCB} = 2.5V ± 0.2V</td><td></td><td>7.4</td><td>14.8</td></tr>
<tr><td>V_{VCCB} = 3.3V ± 0.3V</td><td></td><td>7.6</td><td>15.2</td></tr>
<tr><td>V_{VCCB} = 5.0V ± 0.3V</td><td></td><td>11.9</td><td>23.8</td></tr>
</table>

Output Rise / Fall Time V_{VCCA} = 2.5V ± 0.2V[8]

C_L = 15pF, R_L = 1MΩ, and T_A = -40°C to +85°C.

VCCA	Parameter	Test Condition		Min	Typ	Max	Unit
$t_{RISE(A)}$	Output Rise Time: A Port	Push-pull	V_{VCCB} = 2.5V ± 0.2V		4.8	9.6	ns
			V_{VCCB} = 3.3V ± 0.3V		4.4	8.8	
			V_{VCCB} = 5.0V ± 0.3V		4.4	8.8	
		Open-drain	V_{VCCB} = 2.5V ± 0.2V		98.8	197	
			V_{VCCB} = 3.3V ± 0.3V		81.2	162	
			V_{VCCB} = 5.0V ± 0.3V		58	116	
$t_{RISE(B)}$	Output Rise Time: B Port	Push-pull	V_{VCCB} = 2.5V ± 0.2V		5.6	11.2	ns
			V_{VCCB} = 3.3V ± 0.3V		4.8	9.6	
			V_{VCCB} = 5.0V ± 0.3V		6.5	13	
		Open-drain	V_{VCCB} = 2.5V ± 0.2V		104	208	
			V_{VCCB} = 3.3V ± 0.3V		84	168	
			V_{VCCB} = 5.0V ± 0.3V		36.8	73	
$t_{FALL(A)}$	Output Fall Time: A Port	Push-pull	V_{VCCB} = 2.5V ± 0.2V		6.8	13.6	ns
			V_{VCCB} = 3.3V ± 0.3V		6.8	13.6	
			V_{VCCB} = 5.0V ± 0.3V		6	12	
		Open-drain	V_{VCCB} = 2.5V ± 0.2V		6.9	13.8	
			V_{VCCB} = 3.3V ± 0.3V		6.8	13.6	
			V_{VCCB} = 5.0V ± 0.3V		7.1	14.2	
$t_{FALL(B)}$	Output Fall Time: B Port	Push-pull	V_{VCCB} = 2.5V ± 0.2V		5	10	ns
			V_{VCCB} = 3.3V ± 0.3V		5.6	11.2	
			V_{VCCB} = 5.0V ± 0.3V		8.8	17.6	
		Open-drain	V_{VCCB} = 2.5V ± 0.2V		6.6	13.2	
			V_{VCCB} = 3.3V ± 0.3V		6.6	13.2	
			V_{VCCB} = 5.0V ± 0.3V		8.3	16.6	

Output Rise/Fall Time V_{VCCA} = 3.3V ± 0.3V[8]

C_L = 15pF, R_L = 1MΩ, and T_A = -40°C to +85°C.

Symbol	Parameter	Test Condition		Min	Typ	Max	Unit
$t_{RISE(A)}$	Output Rise Time: A Port	Push-pull	V_{VCCB} = 3.3V ± 0.3V		4.8	9.6	ns
			V_{VCCB} = 5.0V ± 0.3V		3.8	7.6	
		Open-drain	V_{VCCB} = 3.3V ± 0.3V		72	144	
			V_{VCCB} = 5.0V ± 0.3V		46.8	93.6	
$t_{RISE(B)}$	Output Rise Time: B Port	Push-pull	V_{VCCB} = 3.3V ± 0.3V		4.4	8.8	ns
			V_{VCCB} = 5.0V ± 0.3V		4.2	8.4	
		Open-drain	V_{VCCB} = 3.3V ± 0.3V		64	128	
			V_{VCCB} = 5.0V ± 0.3V		38	76	
$t_{FALL(A)}$	Output Fall Time: A Port	Push-pull	V_{VCCB} = 3.3V ± 0.3V		7	14	ns
			V_{VCCB} = 5.0V ± 0.3V		6.4	12.8	
		Open-drain	V_{VCCB} = 3.3V ± 0.3V		7.4	14.8	
			V_{VCCB} = 5.0V ± 0.3V		7.4	14.8	
$t_{FALL(B)}$	Output Fall Time: B Port	Push-pull	V_{VCCB} = 3.3V ± 0.3V		5.4	10.8	ns
			V_{VCCB} = 5.0V ± 0.3V		8.4	16.8	
		Open-drain	V_{VCCB} = 3.3V ± 0.3V		6.4	12.8	
			V_{VCCB} = 5.0V ± 0.3V		8.1	16.2	

Note8: Output rise and fall times guaranteed by design simulation and characterization; not production tested.

Maximum Data Rate [9]

C_L = 15pF, R_L = 1MΩ, and T_A = -40°C to +85°C.

V_{VCCA}	Condition	V_{VCCB}			Unit
		2.5V ± 0.2V	3.3V ± 0.2V	5V ± 0.5V	
1.8V ± 0.15V	Push-Pull	18	21	23	Mbps
	Open-Drain	2	2	2	
2.5V ± 0.2V	Push-Pull	20	20	24	Mbps
	Open-Drain	2	2	2	
3.3V ± 0.3V	Push-Pull	-	22	24	Mbps
	Open-Drain	-	2	2	

AC Characteristics -- V_{VCCA} = 1.8V ± 0.15V[10]

C_L = 15pF, R_L = 1MΩ, and T_A = -40°C to +85°C.

Symbol	Parameter	Test Condition		Min	Typ	Max	Unit
$t_{PHL(A-B)}$	Propagation Delay Time (High to Low), from A (Input) to B (Output)	Push-pull	V_{VCCB} = 2.5V ± 0.2V		3.5	6	ns
			V_{VCCB} = 3.3V ± 0.3V		3.8	5.8	
			V_{VCCB} = 5.0V ± 0.3V		4.9	5.8	
		Open-drain	V_{VCCB} = 2.5V ± 0.2V		14.4	20	
			V_{VCCB} = 3.3V ± 0.3V		14.6	20	
			V_{VCCB} = 5.0V ± 0.3V		15.2	20	
$t_{PHL(B-A)}$	Propagation Delay Time (High to Low), from B (Input) to A (Output)	Push-pull	V_{VCCB} = 2.5V ± 0.2V		3.8	6	ns
			V_{VCCB} = 3.3V ± 0.3V		3.8	6	
			V_{VCCB} = 5.0V ± 0.3V		4.8	6	
		Open-drain	V_{VCCB} = 2.5V ± 0.2V		9.8	20	
			V_{VCCB} = 3.3V ± 0.3V		8	20	
			V_{VCCB} = 5.0V ± 0.3V		10.9	20	
$t_{PLH(A-B)}$	Propagation Delay Time (Low to High), from A (Input) to B (Output)	Push-pull	V_{VCCB} = 2.5V ± 0.2V		3.2	7.7	ns
			V_{VCCB} = 3.3V ± 0.3V		3.6	6.8	
			V_{VCCB} = 5.0V ± 0.3V		3	7	
		Open-drain	V_{VCCB} = 2.5V ± 0.2V		148	200	
			V_{VCCB} = 3.3V ± 0.3V		121.8	200	
			V_{VCCB} = 5.0V ± 0.3V		90.8	200	
$t_{PLH(B-A)}$	Propagation Delay Time (Low to High), from B (Input) to A (Output)	Push-pull	V_{VCCB} = 2.5V ± 0.2V		1.7	5.3	ns
			V_{VCCB} = 3.3V ± 0.3V		1.6	4.5	
			V_{VCCB} = 5.0V ± 0.3V		1.4	4.0	
		Open-drain	V_{VCCB} = 2.5V ± 0.2V		148	200	
			V_{VCCB} = 3.3V ± 0.3V		122	200	
			V_{VCCB} = 5.0V ± 0.3V		86	200	
$t_{en(OE-A)}$ $t_{en(OE-B)}$	Enable Time, from OE (Input) to A or B (Output)	V_{VCCB} = 2.5V ± 0.2V				200	ns
		V_{VCCB} = 3.3V ± 0.3V				200	
		V_{VCCB} = 5.0V ± 0.3V				200	
$t_{dis(OE-A)}$ $t_{dis(OE-B)}$	Disable Time, from OE (Input) to A or B (Output)	V_{VCCB} = 2.5V ± 0.2V				200	ns
		V_{VCCB} = 3.3V ± 0.3V				200	
		V_{VCCB} = 5.0V ± 0.3V				200	
t_{sk}	Channel-to-channel Skew[11]	V_{VCCB} = 2.5V ± 0.2V				1	ns
		V_{VCCB} = 3.3V ± 0.3V				1	
		V_{VCCB} = 5.0V ± 0.3V				1	

AC Characteristics -- V_{VCCA} = 2.5V ± 0.2V[10]

C_L = 15pF, R_L = 1MΩ, and T_A = -40°C to +85°C.

Symbol	Parameter	Test Condition		Min	Typ	Max	Unit
$t_{PHL(A-B)}$	Propagation Delay Time (High to Low), from A (Input) to B (Output)	Push-pull	V_{VCCB} = 2.5V ± 0.2V		4.4	8	ns
			V_{VCCB} = 3.3V ± 0.3V		4.4	8	
			V_{VCCB} = 5.0V ± 0.3V		5.6	9	
		Open-drain	V_{VCCB} = 2.5V ± 0.2V		9.6	20	
			V_{VCCB} = 3.3V ± 0.3V		9.6	20	
			V_{VCCB} = 5.0V ± 0.3V		9.8	20	
$t_{PHL(B-A)}$	Propagation Delay Time (High to Low), from B (Input) to A (Output)	Push-pull	V_{VCCB} = 2.5V ± 0.2V		4	8	ns
			V_{VCCB} = 3.3V ± 0.3V		3.6	8	
			V_{VCCB} = 5.0V ± 0.3V		4.6	9	
		Open-drain	V_{VCCB} = 2.5V ± 0.2V		10	20	
			V_{VCCB} = 3.3V ± 0.3V		8	20	
			V_{VCCB} = 5.0V ± 0.3V		6.6	20	
$t_{PLH(A-B)}$	Propagation Delay Time (Low to High), from A (Input) to B (Output)	Push-pull	V_{VCCB} = 2.5V ± 0.2V		3.3	6	ns
			V_{VCCB} = 3.3V ± 0.3V		2.7	6	
			V_{VCCB} = 5.0V ± 0.3V		2.4	5	
		Open-drain	V_{VCCB} = 2.5V ± 0.2V		138	200	
			V_{VCCB} = 3.3V ± 0.3V		116	200	
			V_{VCCB} = 5.0V ± 0.3V		84	200	
$t_{PLH(B-A)}$	Propagation Delay Time (Low to High), from B (Input) to A (Output)	Push-pull	V_{VCCB} = 2.5V ± 0.2V		2.1	5	ns
			V_{VCCB} = 3.3V ± 0.3V		2	5	
			V_{VCCB} = 5.0V ± 0.3V		1.8	4	
		Open-drain	V_{VCCB} = 2.5V ± 0.2V		142	200	
			V_{VCCB} = 3.3V ± 0.3V		113	200	
			V_{VCCB} = 5.0V ± 0.3V		84	200	
$t_{en(OE-A)}$ $t_{en(OE-B)}$	Enable Time, from OE (Input) to A or B (Output)	V_{VCCB} = 2.5V ± 0.2V				200	ns
		V_{VCCB} = 3.3V ± 0.3V				200	
		V_{VCCB} = 5.0V ± 0.3V				200	
$t_{dis(OE-A)}$ $t_{dis(OE-B)}$	Disable Time, from OE (Input) to A or B (Output)	V_{VCCB} = 2.5V ± 0.2V				200	ns
		V_{VCCB} = 3.3V ± 0.3V				200	
		V_{VCCB} = 5.0V ± 0.3V				200	
t_{sk}	Channel-to-channel Skew[11]	V_{VCCB} = 2.5V ± 0.2V				1	ns
		V_{VCCB} = 3.3V ± 0.3V				1	
		V_{VCCB} = 5.0V ± 0.3V				1	

AC Characteristics -- V_{VCCA} = 3.3V ± 0.3V[10]

C_L = 15pF, R_L = 1MΩ, and T_A = -40°C to +85°C.

Symbol	Parameter	Test Condition		Min	Typ	Max	Unit
$t_{PHL(A-B)}$	Propagation Delay Time (High to Low), from A (Input) to B (Output)	Push-pull	V_{VCCB} = 3.3V ± 0.3V		5	9	ns
			V_{VCCB} = 5.0V ± 0.3V		5.6	10	
		Open-drain	V_{VCCB} = 3.3V ± 0.3V		7.2	15	
			V_{VCCB} = 5.0V ± 0.3V		7.7	16	
$t_{PHL(B-A)}$	Propagation Delay Time (High to Low), from B (Input) to A (Output)	Push-pull	V_{VCCB} = 3.3V ± 0.3V		5.4	10	ns
			V_{VCCB} = 5.0V ± 0.3V		5.4	10	
		Open-drain	V_{VCCB} = 3.3V ± 0.3V		8.4	20	
			V_{VCCB} = 5.0V ± 0.3V		6.4	15	
$t_{PLH(A-B)}$	Propagation Delay Time (Low to High), from A (Input) to B (Output)	Push-pull	V_{VCCB} = 3.3V ± 0.3V		2.4	4.2	ns
			V_{VCCB} = 5.0V ± 0.3V		2	4.4	
		Open-drain	V_{VCCB} = 3.3V ± 0.3V		112	200	
			V_{VCCB} = 5.0V ± 0.3V		82	200	
$t_{PLH(B-A)}$	Propagation Delay Time (Low to High), from B (Input) to A (Output)	Push-pull	V_{VCCB} = 3.3V ± 0.3V		1.7	4	ns
			V_{VCCB} = 5.0V ± 0.3V		1.5	3	
		Open-drain	V_{VCCB} = 3.3V ± 0.3V		111	200	
			V_{VCCB} = 5.0V ± 0.3V		85	200	
$t_{en(OE-A)}$ $t_{en(OE-B)}$	Enable Time, from OE (Input) to A or B (Output)	Push-pull	V_{VCCB} = 3.3V ± 0.3V			200	ns
		Open-drain	V_{VCCB} = 5.0V ± 0.3V			200	
$t_{dis(OE-A)}$ $t_{dis(OE-B)}$	Disable Time, from OE (Input) to A or B (Output)	Push-pull	V_{VCCB} = 3.3V ± 0.3V			200	ns
		Open-drain	V_{VCCB} = 5.0V ± 0.3V			200	
t_{sk}	Channel-to-channel Skew[11]	Push-pull	V_{VCCB} = 3.3V ± 0.3V			1	ns
		Open-drain	V_{VCCB} = 5.0V ± 0.3V			1	

Note9/10: AC characteristics are guaranteed by design and characterization.

Note11: Skew is the variation of propagation delay between output signals and applies only to output signals on the same port (An or Bn) and switching with the same polarity (Low to High or High to Low). Skew is guaranteed; not production tested.

AC Test Reference Circuit

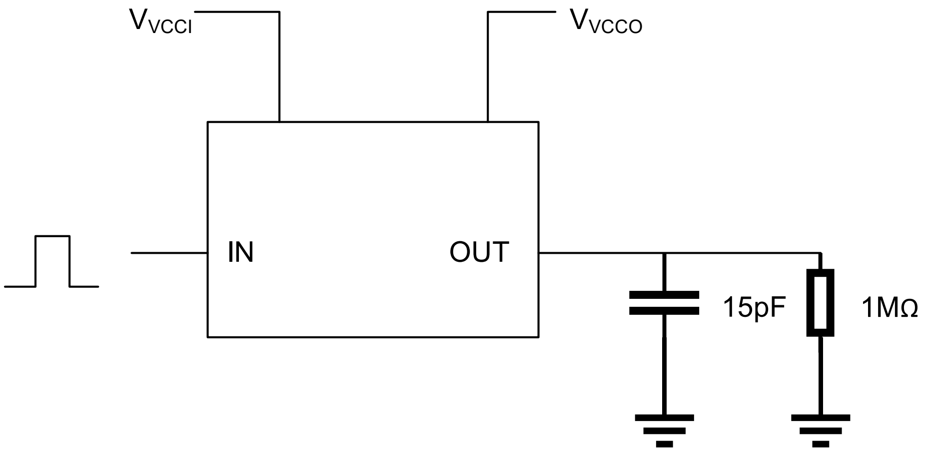


Figure5. AC Test Circuit, Data Rate, Pulse Duration, Propagation Delay, Output Rise-Time and Fall-Time Measurement Using a Push-Pull Drive

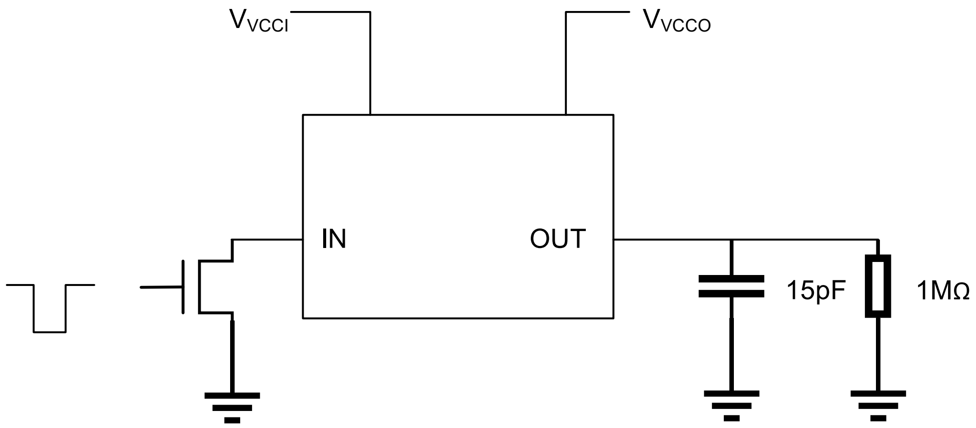
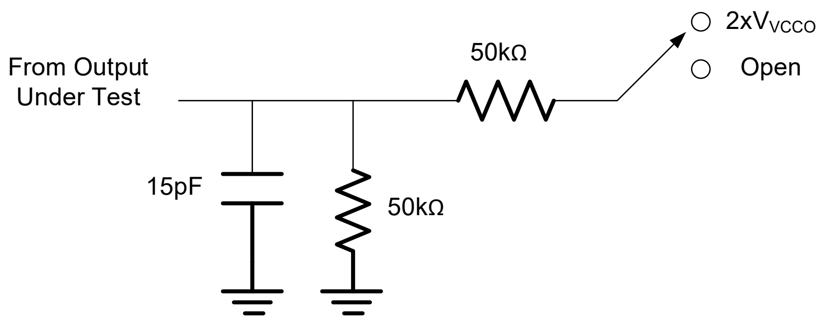


Figure6. AC Test Circuit, Data Rate, Pulse Duration, Propagation Delay, Output Rise-Time and Fall-Time Measurement Using an Open-Drain Driver



Test	Switch
t_{PZH}, t_{PHZ}	Open
t_{PZL}, t_{PLZ}	2 × V_{VCCO}

Figure7. AC Test Circuit, Load Circuit for Enable-Time and Disable-Time Measurement

AC Test Reference Conditions

Propagation Delay Test Conditions

Test	Input Signal	Output Enable Control
t_{PLH}, t_{PHL}	Data Pulses	V_{VCCA}
t_{PZL} (t_{en}, OE to An, Bn)	Low	Low to High Switch
t_{PZH} (t_{en}, OE to An, Bn)	High	Low to High Switch
t_{PLZ} (t_{dis}, OE to An, Bn)	Low	High to Low Switch
t_{PHZ} (t_{dis}, OE to An, Bn)	High	High to Low Switch

AC Load Conditions

V_{VCCO}	C_L	R_L
1.8 ± 0.15V	15pF	1MΩ
2.5 ± 0.2V	15pF	1MΩ
3.3 ± 0.3V	15pF	1MΩ
5.0 ± 0.5V	15pF	1MΩ

Timing Diagrams

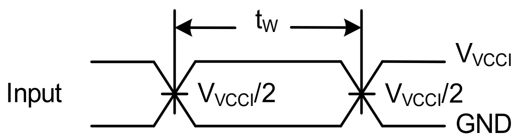


Figure8. Pulse Duration

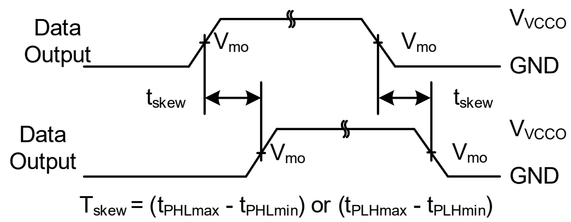


Figure9. Output Skew Time

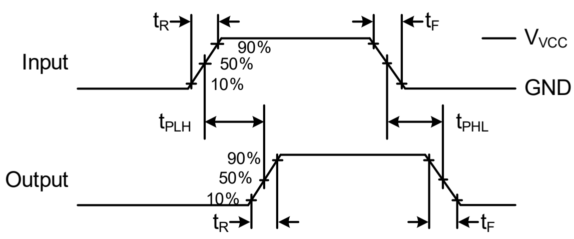


Figure10. Propagation Delay

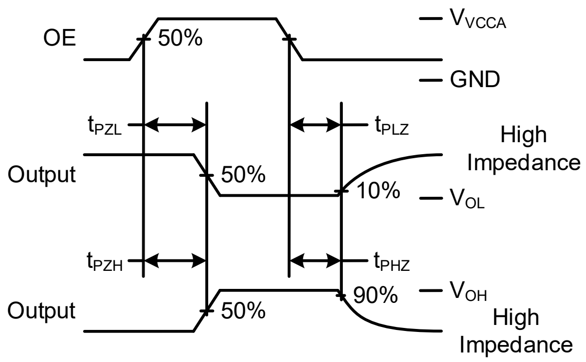
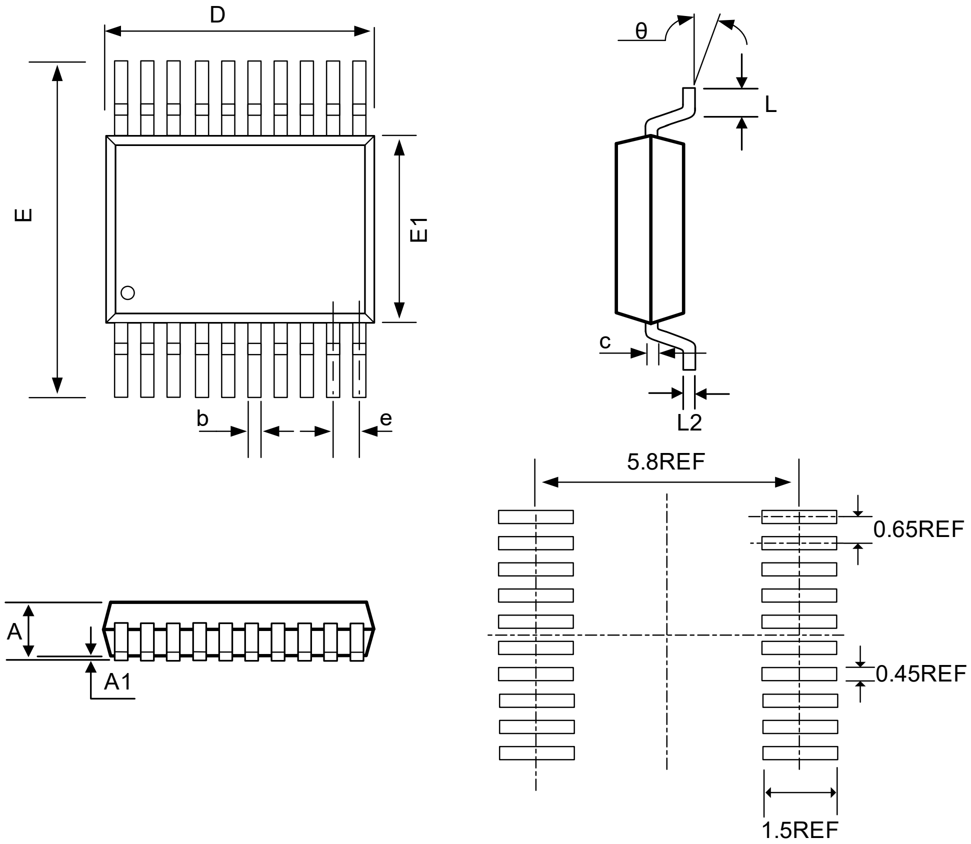


Figure11. Enable and Disable Times

Package Dimension

TSSOP20 (4.4mm ×6.5mm)



COMMON DIMENSIONS

(Unit: mm)

Symbol	Min	Max
A	--	1.20
A1	0.05	0.15
b	0.19	0.30
c	0.15 REF	
D	6.40	6.60
E	6.20	6.60
E1	4.30	4.50
e	0.65BSC	
L	0.50	0.72
L2	0.25 REF	
θ	0°	8°

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1.0	2025-10-25	Initial Version	Zhang Wang	Shi Pu Kun	Liu Jia Ying