

Features

- 8-bit Bidirectional Level Shift, Push-Pull Output
- Max Data Rate (Push-Pull):
 - 100 Mbps at $V_{CCA} = 3.3\text{ V}$ and $V_{CCB} = 5\text{ V}$
- Voltage-Level Translation Between:
 - V_{CCA} Range: 1.2 V to 3.6 V
 - V_{CCB} Range: 1.65 V to 5.5 V
- 5-V Tolerant OE (Output Enable) Pin
- High-impedance A1~8 and B1~8 Pins for OE = LOW
- VCC Isolation Feature: Either VCC Input = GND, All Outputs in the High-impedance State
- I_{OFF} Supports Partial Power-down Mode
- No Power Up Sequence Required for V_{CCA} and V_{CCB}
- ESD Protection:
 - A Port $\pm 4000\text{-V}$ Human-Body Model
 - B Port $\pm 8000\text{-V}$ Human-Body Model
 - B Port $\pm 4000\text{-V}$ IEC 61000-4-2 Contact Discharge
 - 1500-V Charged-Device Model

Applications

- Automotive and Transportation
 - Body Electronics / Lighting
 - Power Train / Chassis
 - Infotainment / Cluster
 - ADAS / Safety
- GPIO, UART, and other Interfaces

Description

The TPT20208 device is an 8-bit level shifter, with an enable (OE) input and can work within the V_{CCA} range from 1.2 V to 3.6 V and the V_{CCB} range from 1.65 V to 5.5 V. V_{CCA} must be less than or equal to V_{CCB} . TPT20208 supports bidirectional voltage translation among 1.2 V, 1.5 V, 1.8 V, 2.5 V, 3.3 V, and 5 V.

The A1~8 I/Os are connected to the B1~8 I/Os, which allows bidirectional data flowing between ports. If OE is low, the translator switch is off, and a high-impedance state exists between port A and port B to isolate both sides. The OE input circuit is internally connected to V_{CCA} .

The 8-bit bidirectional buffer isolates capacitance and allows 15 pF on either side of the device to support 100 Mbps speed in Push-Pull mode in 3.3 V V_{CCA} and 5 V V_{CCB} supply.

The TPT20208 is available in the QFN3.5X4.5-20 and TSSOP-20 package and is characterized from -40°C to $+125^{\circ}\text{C}$.

Typical Application

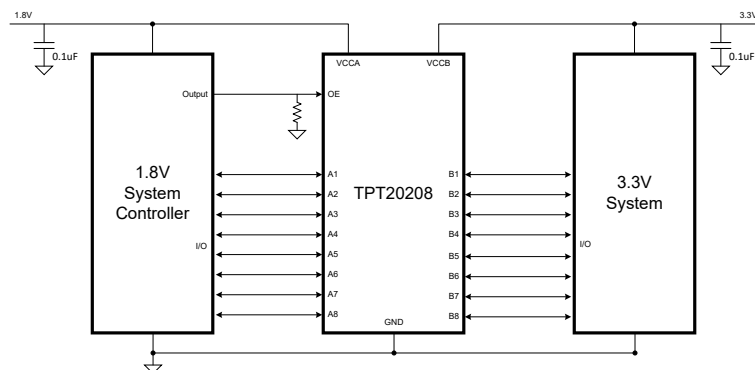


Table of Contents

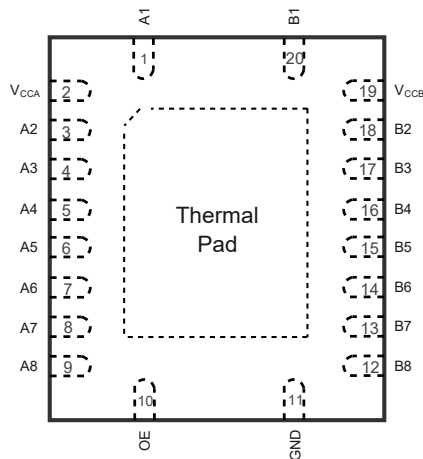
Features	1
Applications	1
Description	1
Typical Application	1
Revision History	3
Pin Configuration and Functions	4
Specifications	6
Absolute Maximum Ratings ⁽¹⁾	6
ESD, Electrostatic Discharge Protection.....	6
Recommended Operating Conditions.....	7
Thermal Information.....	7
Electrical Characteristics.....	8
AC Timing Requirements — VCCA = 1.2 V.....	10
AC Timing Requirements — VCCA = 1.5 V.....	12
AC Timing Requirements — VCCA = 1.8 V.....	14
AC Timing Requirements — VCCA = 2.5 V.....	16
AC Timing Requirements — VCCA = 3.3 V.....	17
Parameter Measurement Waveforms.....	18
Detailed Description	19
Overview.....	19
Functional Block Diagram.....	19
Feature Description.....	19
Application and Implementation	21
Application Information	21
Typical Application.....	21
Layout	22
Layout Example.....	22
Tape and Reel Information	23
Package Outline Dimensions	24
QFN3.5X4.5-20.....	24
TSSOP20.....	25
Order Information	26
IMPORTANT NOTICE AND DISCLAIMER	27

Revision History

Date	Revision	Notes
2024-08-01	Rev.P.0	Initial version
2026-01-31	Rev.A.0	Released version

Pin Configuration and Functions

TPT20208-QN7R
QFN3.5X4.5-20
Top View



TPT20208-TS4R
TSSOP-20
Top View

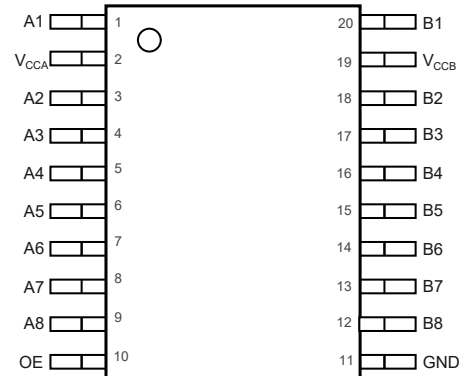


Table 1. Pin Functions: TPT20208

Pin		I/O	Description
No.	Name		
1	A1	I/O	Input/output A1. Referenced to V _{CCA}
2	V _{CCA}	P	Side-A Supply Voltage
3	A2	I/O	Input/output A2. Referenced to V _{CCA}
4	A3	I/O	Input/output A3. Referenced to V _{CCA}
5	A4	I/O	Input/output A4. Referenced to V _{CCA}
6	A5	I/O	Input/output A5. Referenced to V _{CCA}
7	A6	I/O	Input/output A6. Referenced to V _{CCA}
8	A7	I/O	Input/output A7. Referenced to V _{CCA}
9	A8	I/O	Input/output A8. Referenced to V _{CCA}
10	OE	I	Active-high Enable Input, Reference to V _{CCA} , not allowed to be Floating
11	GND	P	Supply ground
12	B8	I/O	Input/output B8. Referenced to V _{CCB}
13	B7	I/O	Input/output B7. Referenced to V _{CCB}
14	B6	I/O	Input/output B6. Referenced to V _{CCB}
15	B5	I/O	Input/output B5. Referenced to V _{CCB}
16	B4	I/O	Input/output B4. Referenced to V _{CCB}
17	B3	I/O	Input/output B3. Referenced to V _{CCB}
18	B2	I/O	Input/output B2. Referenced to V _{CCB}

8-bit Bidirectional Level Shifter, Push-Pull Mode

Pin		I/O	Description
No.	Name		
19	V _{CCB}	P	Side-B Supply Voltage
20	B1	I/O	Input/output B1. Referenced to V _{CCB}
-	Epad	-	For the QFN package, the exposed thermal pad must be connected to ground

8-bit Bidirectional Level Shifter, Push-Pull Mode

Specifications

Absolute Maximum Ratings ⁽¹⁾

Parameter		Min	Max	Unit
V _{CCA}	DC Reference Voltage Range (Side-A)	-0.5	4.6	V
V _{CCB}	DC Reference Bias Voltage Range (Side-B)	-0.5	6.5	V
V _I	Input Voltage Range, Side-A	-0.5	4.6	V
	Input Voltage Range, Side-B	-0.5	6.5	V
V _O	Voltage Range Applied to Any Output in the High-impedance or Power-off State, V _O , Side-A	-0.5	4.6	V
	Voltage Range Applied to Any Output in the High-impedance or Power-off State, V _O , Side-B	-0.5	6.5	V
	Voltage Range Applied to Any Output in the High or Low State, V _O , Side-A	-0.5	V _{CCA} + 0.5	V
	Voltage Range Applied to Any Output in the High or Low State, V _O , Side-B	-0.5	V _{CCB} + 0.5	V
I _{IK}	Input Clamp Current, V _I < 0		-50	mA
I _{OK}	Output Clamp Current, V _{I/O} < 0		-50	mA
I _O	Continuous Output Current	-50	50	mA
I _C	Continuous Current through Each V _{CCA} , V _{CCB} , or GND	-100	100	mA
T _J	Maximum Junction Temperature		150	°C
T _{STG}	Storage Temperature Range	-65	150	°C

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

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

(3) The values of V_{CCA} and V_{CCB} are provided in the recommended operating conditions table.

ESD, Electrostatic Discharge Protection

Parameter		Condition	Value	Unit
HBM	Human Body Model ESD, Side-A ports	ANSI/ESDA/JEDEC JS-001 ⁽¹⁾	±4	kV
	Human Body Model ESD, Side-B ports	ANSI/ESDA/JEDEC JS-001 ⁽¹⁾	±8	kV
IEC ESD	IEC Contact Discharge	IEC-61000-4-2, Bus Pin: B ports	±4	kV
	IEC Air-Gap Discharge	IEC-61000-4-2, Bus Pin: B ports	±8	kV
CDM	Charged Device Model ESD, Side-A and Side-B Ports	ANSI/ESDA/JEDEC JS-002 ⁽²⁾	±1.5	kV
LU	Latch up	LU, per JESD78, All Pins ⁽³⁾	±500	mA

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

(3) Test at the temperature of 25°C.

8-bit Bidirectional Level Shifter, Push-Pull Mode

Recommended Operating Conditions

Parameter		V _{CCA}	V _{CCB}	Min	Max	Unit
V _{CCA}	Reference Voltage, Side-A			1.2	3.6	V
V _{CCB}	Reference Voltage, Side-B			1.65	5.5	V
V _{IH}	Side-A Ports High-level Input Voltage	1.2 V to 1.95 V	1.65 V to 5.5 V	$V_{CCI}^{(1)} \times 0.65$	$V_{CCI}^{(1)}$	V
	Side-B Ports High-level Input Voltage	1.2 V to 3.6 V	1.65 V to 5.5 V	$V_{CCI}^{(1)} \times 0.65$	$V_{CCI}^{(1)}$	V
	OE Inputs High-level Input Voltage	1.2 V to 3.6 V	1.65 V to 5.5 V	$V_{CCA} \times 0.65$	5.5	V
V _{IL}	Side-A Ports Low-level Input Voltage	1.2 V to 3.6 V	1.65 V to 5.5 V	0	$V_{CCI}^{(1)} \times 0.35$	V
	Side-B Ports Low-level Input Voltage	1.2 V to 3.6 V	1.65 V to 5.5 V	0	$V_{CCI}^{(1)} \times 0.35$	V
	OE Inputs Low-level Input Voltage	1.2 V to 3.6 V	1.65 V to 5.5 V	0	$V_{CCA} \times 0.35$	V
$\Delta t/\Delta v$	Side-A Ports Input Transition Rise or Fall Rate	1.2 V to 3.6 V	1.65 V to 5.5 V		40	ns/V
	Side-B Ports Input Transition Rise or Fall Rate	1.2 V to 3.6 V	1.65 V to 5.5 V		40	
	OE Input Transition Rise or Fall Rate	1.2 V to 3.6 V	1.65 V to 5.5 V		40	
T _A	Operating Ambient Temperature			-40	125	°C

(1) V_{CCI} is the supply voltage of the input side-A or side-B port.

(2) V_{CCA} should be less than or equal to V_{CCB}, and V_{CCA} must not be higher than 3.6 V.

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
QFN3.5X4.5-20	171	80	°C/W
TSSOP-20	113	49	°C/W

8-bit Bidirectional Level Shifter, Push-Pull Mode

Electrical Characteristics

All test conditions: $V_{CCA} = 1.2\text{ V to }3.6\text{ V}$, $V_{CCB} = 1.65\text{ V to }5.5\text{ V}$, $V_{CCA} \leq V_{CCB}$, $T_A = -40^\circ\text{C to }+125^\circ\text{C}$, unless otherwise noted.

Parameter	Conditions	V_{CCA}	V_{CCB}	Min	Typ	Max	Unit
V_{OHA}	Port A High-level Output Voltage	$I_{OH} = -20\text{ }\mu\text{A}$, $T_A = 25^\circ\text{C}$	1.2 V	1.65 V to 5.5 V		1.1	
		$I_{OH} = -20\text{ }\mu\text{A}$	1.4 V to 3.6 V	1.65 V to 5.5 V	$V_{CCA} - 0.4$		V
V_{OLA}	Port A Low-level Output Voltage	$I_{OL} = 20\text{ }\mu\text{A}$, $T_A = 25^\circ\text{C}$	1.2 V	1.65 V to 5.5 V		0.09	
		$I_{OL} = 20\text{ }\mu\text{A}$	1.4 V to 3.6 V	1.65 V to 5.5 V		0.4	V
V_{OHB}	Port B High-level Output Voltage	$I_{OH} = -20\text{ }\mu\text{A}$	1.2 V to 3.6 V	1.65 V to 5.5 V	$V_{CCB} - 0.4$		V
V_{OLB}	Port B Low-level Output Voltage	$I_{OL} = 20\text{ }\mu\text{A}$	1.2 V to 3.6 V	1.65 V to 5.5 V		0.4	V
I_I	Input Leakage Current	OE: $V_I = V_{CCI}$ or GND	1.2 V to 3.6 V	1.65 V to 5.5 V	-5	5	μA
I_{OZ}	High-impedance State Output Current	Port A or B, OE = GND	1.2 V to 3.6 V	1.65 V to 5.5 V	-10	10	μA
I_{OFF}	OFF Current	A port: V_I or $V_O = 0\text{ V to }3.6\text{ V}$	0 V	0 V to 5.5 V	-10	10	μA
		B port: V_I or $V_O = 0\text{ V to }5.5\text{ V}$	0 V to 3.6 V	0 V	-10	10	μA
I_{CCA}	Quiescent Supply Current for V_{CCA}	$V_I = V_{CCI}$ or GND, $I_O = 0\text{ V}$, OE = V_{CCA} , $T_A = 25^\circ\text{C}$	1.2 V	1.65 V to 5.5 V		0.8	
		$V_I = V_{CCI}$ or GND, $I_O = 0\text{ V}$, OE = V_{CCA}	1.4 V to 3.6 V	1.65 V to 5.5 V		40	μA
			3.6 V	0		30	
			0	5.5 V	-30		
I_{CCB}	Quiescent Supply Current for V_{CCB}	$V_I = V_{CCI}$ or GND, $I_O = 0\text{ V}$, OE = V_{CCA} , $T_A = 25^\circ\text{C}$	1.2 V	1.65 V to 5.5 V		6.8	
		$V_I = V_{CCI}$ or GND, $I_O = 0\text{ V}$, OE = V_{CCA}	1.4 V to 3.6 V	1.65 V to 5.5 V		40	μA
			3.6 V	0	-30		
			0	5.5 V		30	
I_{CCA+} I_{CCB}	Combined Supply Current	$V_I = V_{CCI}$ or GND, $I_O = 0\text{ V}$, OE = V_{CCA} , $T_A = 25^\circ\text{C}$	1.2 V	1.65 V to 5.5 V		7	
		$V_I = V_{CCI}$ or GND, $I_O = 0\text{ V}$, OE = V_{CCA}	1.4 V to 3.6 V	1.65 V to 5.5 V		80	μA

8-bit Bidirectional Level Shifter, Push-Pull Mode

Parameter		Conditions	V _{CCA}	V _{CCB}	Min	Typ	Max	Unit
I _{CCZA}	High-Impedance State V _{CCA} Supply Current	V _I = V _{CCI} or GND, I _O = 0 V, OE = GND, T _A = 25°C	1.2 V	1.65 V to 5.5 V		0.8		
		V _I = V _{CCI} or GND, I _O = 0 V, OE = GND	1.4 V to 3.6 V	1.65 V to 5.5 V			30	μA
I _{CCZB}	High-Impedance State V _{CCB} Supply Current	V _I = V _{CCI} or GND, I _O = 0 V, OE = GND, T _A = 25°C	1.2 V	1.65 V to 5.5 V		6.6		
		V _I = V _{CCI} or GND, I _O = 0 V, OE = GND	1.4 V to 3.6 V	1.65 V to 5.5 V			30	μA
C _I	Input Capacitance ⁽¹⁾	OE	3.3 V	3.3 V		5	10	pF
C _{IO}	Input/Output Capacitance ⁽¹⁾	Port A	3.3 V	3.3 V		7	10	pF
		Port B	3.3 V	3.3 V		10	15	pF

(1) Test data based on bench tests and design simulation, NOT test in production.

8-bit Bidirectional Level Shifter, Push-Pull Mode

AC Timing Requirements — $V_{CCA} = 1.2\text{ V}$

All test conditions: $V_{CCA} = 1.2\text{ V}$, $T_A = 25^\circ\text{C}$, unless otherwise noted.

The data is based on bench test and design simulation, not test in production.

Parameter		Condition	V_{CCB}	Min	Typ	Max	Unit
f_D	Data Rate	Push-pull mode	1.65 V to 1.95 V			20	Mbps
			2.3 V to 2.7 V			20	Mbps
			3.0 V to 3.6 V			20	Mbps
			4.5 V to 5.5 V			20	Mbps
t_W	Pulse Duration	Push-pull mode	1.65 V to 1.95 V	50			ns
			2.3 V to 2.7 V	50			ns
			3.0 V to 3.6 V	50			ns
			4.5 V to 5.5 V	50			ns
t_{PHL}	Propagation Delay (High-to-Low)	A-to-B, push-pull driving	1.65 V to 1.95 V		10.1		ns
			2.3 V to 2.7 V		7.8		ns
			3.0 V to 3.6 V		7.2		ns
			4.5 V to 5.5 V		7		ns
t_{PLH}	Propagation Delay (Low-to-High)	A-to-B, push-pull driving	1.65 V to 1.95 V		9.5		ns
			2.3 V to 2.7 V		6.9		ns
			3.0 V to 3.6 V		6		ns
			4.5 V to 5.5 V		5.5		ns
t_{PHL}	Propagation Delay (High-to-Low)	B-to-A, push-pull driving	1.65 V to 1.95 V		11		ns
			2.3 V to 2.7 V		8.9		ns
			3.0 V to 3.6 V		8.2		ns
			4.5 V to 5.5 V		7.7		ns
t_{PLH}	Propagation Delay (Low-to-High)	B-to-A, push-pull driving	1.65 V to 1.95 V		10.3		ns
			2.3 V to 2.7 V		8.9		ns
			3.0 V to 3.6 V		8.5		ns
			4.5 V to 5.5 V		8.1		ns
t_{en}	Enable Time	OE-to-A or B, push-pull driving	1.65 V to 5.5 V		80		ns
t_{dis}	Disable Time	OE-to-A or B, push-pull driving	1.65 V to 5.5 V		170		ns

8-bit Bidirectional Level Shifter, Push-Pull Mode

Parameter		Condition	V _{CCB}	Min	Typ	Max	Unit
tr _A	Input Rise Time	A-port rise time, push-pull driving	1.65 V to 1.95 V		4.6		ns
			2.3 V to 2.7 V		4.3		ns
			3.0 V to 3.6 V		4.3		ns
			4.5 V to 5.5 V		4.3		ns
tr _B	Input Rise Time	B-port rise time, push-pull driving	1.65 V to 1.95 V		2.3		ns
			2.3 V to 2.7 V		1.7		ns
			3.0 V to 3.6 V		1.5		ns
			4.5 V to 5.5 V		1.3		ns
tf _A	Input Fall Time	A-port fall time, push-pull driving	1.65 V to 1.95 V		3.4		ns
			2.3 V to 2.7 V		3.3		ns
			3.0 V to 3.6 V		3.1		ns
			4.5 V to 5.5 V		3.6		ns
tf _B	Input Fall Time	B-port fall time, push-pull driving	1.65 V to 1.95 V		1.9		ns
			2.3 V to 2.7 V		1.5		ns
			3.0 V to 3.6 V		1.3		ns
			4.5 V to 5.5 V		1.2		ns
t _{sk(O)}	Skew (time), Output	Channel-to-channel skew, push-pull driving	1.65 V to 5.5 V			1	ns

8-bit Bidirectional Level Shifter, Push-Pull Mode

AC Timing Requirements — $V_{CCA} = 1.5\text{ V}$

All test conditions: $V_{CCA} = 1.4\text{ V}$ to 1.6 V , $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, unless otherwise noted.

The data is based on bench test and design simulation, not test in production.

Parameter		Condition	V_{CCB}	Min	Typ	Max	Unit
f_D	Data Rate	Push-pull mode	1.65 V to 1.95 V			35	Mbps
			2.3 V to 2.7 V			40	Mbps
			3.0 V to 3.6 V			45	Mbps
			4.5 V to 5.5 V			45	Mbps
t_W	Pulse Duration	Push-pull mode	1.65 V to 1.95 V	33.3			ns
			2.3 V to 2.7 V	25			ns
			3.0 V to 3.6 V	22.2			ns
			4.5 V to 5.5 V	22.2			ns
t_{PHL}	Propagation Delay (High-to-Low)	A-to-B, or B-to-A, push-pull driving	1.65 V to 1.95 V			21	ns
			2.3 V to 2.7 V			15	ns
			3.0 V to 3.6 V			15	ns
			4.5 V to 5.5 V			15	ns
t_{PLH}	Propagation Delay (Low-to-High)	A-to-B, or B-to-A, push-pull driving	1.65 V to 1.95 V			20	ns
			2.3 V to 2.7 V			15	ns
			3.0 V to 3.6 V			15	ns
			4.5 V to 5.5 V			15	ns
t_{en}	Enable Time	OE-to-A or B, push-pull driving	1.65 V to 5.5 V			150	ns
t_{dis}	Disable Time	OE-to-A or B, push-pull driving	1.65 V to 5.5 V			500	ns
t_{rA}	Input Rise Time	A-port rise time, push-pull driving	1.65 V to 1.95 V			20	ns
			2.3 V to 2.7 V	1.6		15	ns
			3.0 V to 3.6 V	1.4		15	ns
			4.5 V to 5.5 V	1.4		15	ns
t_{rB}	Input Rise Time	B-port rise time, push-pull driving	1.65 V to 1.95 V	1.3		20	ns
			2.3 V to 2.7 V	1.3		15	ns
			3.0 V to 3.6 V	0.9		15	ns
			4.5 V to 5.5 V	0.7		15	ns

8-bit Bidirectional Level Shifter, Push-Pull Mode

Parameter		Condition	V _{CCB}	Min	Typ	Max	Unit
t _{fA}	Input Fall Time	A-port fall time, push-pull driving	1.65 V to 1.95 V	1		20	ns
			2.3 V to 2.7 V	1.6		20	ns
			3.0 V to 3.6 V	1.4		15	ns
			4.5 V to 5.5 V	1.4		15	ns
t _{fB}	Input Fall Time	B-port fall time, push-pull driving	1.65 V to 1.95 V	1.3		20	ns
			2.3 V to 2.7 V	1.3		15	ns
			3.0 V to 3.6 V	0.9		10	ns
			4.5 V to 5.5 V	0.7		10	ns
t _{SK(O)}	Skew (time), Output	Channel-to-channel skew, push-pull driving	1.65 V to 5.5 V			1	ns

8-bit Bidirectional Level Shifter, Push-Pull Mode

AC Timing Requirements — $V_{CCA} = 1.8\text{ V}$

All test conditions: $V_{CCA} = 1.65\text{ V}$ to 1.95 V , $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, unless otherwise noted.

The data is based on bench test and design simulation, not test in production.

Parameter		Condition	V_{CCB}	Min	Typ	Max	Unit
f_D	Data Rate	Push-pull mode	1.65 V to 1.95 V			35	Mbps
			2.3 V to 2.7 V			50	Mbps
			3.0 V to 3.6 V			60	Mbps
			4.5 V to 5.5 V			60	Mbps
t_W	Pulse Duration	Push-pull mode	1.65 V to 1.95 V	28.6			ns
			2.3 V to 2.7 V	20			ns
			3.0 V to 3.6 V	16.7			ns
			4.5 V to 5.5 V	16.7			ns
t_{PHL}	Propagation Delay (High-to-Low)	A-to-B, or B-to-A, push-pull driving	1.65 V to 1.95 V			20	ns
			2.3 V to 2.7 V			20	ns
			3.0 V to 3.6 V			15	ns
			4.5 V to 5.5 V			15	ns
t_{PLH}	Propagation Delay (Low-to-High)	A-to-B, or B-to-A, push-pull driving	1.65 V to 1.95 V			20	ns
			2.3 V to 2.7 V			20	ns
			3.0 V to 3.6 V			15	ns
			4.5 V to 5.5 V			15	ns
t_{en}	Enable Time	OE-to-A or B, push-pull driving	1.65 V to 5.5 V			100	ns
t_{dis}	Disable Time	OE-to-A or B, push-pull driving	1.65 V to 5.5 V			410	ns
t_{rA}	Input Rise Time	A-port rise time, push-pull driving	1.65 V to 1.95 V			20	ns
			2.3 V to 2.7 V	1.6		20	ns
			3.0 V to 3.6 V	1.4		15	ns
			4.5 V to 5.5 V	1.4		15	ns
t_{rB}	Input Rise Time	B-port rise time, push-pull driving	1.65 V to 1.95 V	1.3		22	ns
			2.3 V to 2.7 V	1.3		20	ns
			3.0 V to 3.6 V	0.9		15	ns
			4.5 V to 5.5 V	0.7		15	ns

8-bit Bidirectional Level Shifter, Push-Pull Mode

Parameter		Condition	V _{CCB}	Min	Typ	Max	Unit
t _{fA}	Input Fall Time	A-port fall time, push-pull driving	1.65 V to 1.95 V	1		20	ns
			2.3 V to 2.7 V	1.6		20	ns
			3.0 V to 3.6 V	1.4		15	ns
			4.5 V to 5.5 V	1.4		15	ns
t _{fB}	Input Fall Time	B-port fall time, push-pull driving	1.65 V to 1.95 V	1.3		20	ns
			2.3 V to 2.7 V	1.3		15	ns
			3.0 V to 3.6 V	0.9		10	ns
			4.5 V to 5.5 V	0.7		10	ns
t _{SK(O)}	Skew (time), Output	Channel-to-channel skew, push-pull driving	1.65 V to 5.5 V			1	ns

8-bit Bidirectional Level Shifter, Push-Pull Mode

AC Timing Requirements — $V_{CCA} = 2.5\text{ V}$

All test conditions: $V_{CCA} = 2.3\text{ V}$ to 2.7 V , $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, unless otherwise noted.

The data is based on bench test and design simulation, not test in production.

Parameter		Condition	VCCB	Min	Typ	Max	Unit
f_D	Data Rate	Push-pull mode	2.3 V to 2.7 V			65	Mbps
			3.0 V to 3.6 V			80	Mbps
			4.5 V to 5.5 V			90	Mbps
t_W	Pulse Duration	Push-pull mode	2.3 V to 2.7 V	15.4			ns
			3.0 V to 3.6 V	12.5			ns
			4.5 V to 5.5 V	11.1			ns
t_{PHL}	Propagation Delay (High-to-Low)	A-to-B, or B-to-A, push-pull driving	2.3 V to 2.7 V			15	ns
			3.0 V to 3.6 V			15	ns
			4.5 V to 5.5 V			15	ns
t_{PLH}	Propagation Delay (Low-to-High)	A-to-B, or B-to-A, push-pull driving	2.3 V to 2.7 V			15	ns
			3.0 V to 3.6 V			15	ns
			4.5 V to 5.5 V			15	ns
t_{en}	Enable Time	OE-to-A or B, push-pull driving	2.3 V to 5.5 V			100	ns
t_{dis}	Disable Time	OE-to-A or B, push-pull driving	2.3 V to 5.5 V			400	ns
t_{rA}	Input Rise Time	A-port rise time, push-pull driving	2.3 V to 2.7 V	1.9		15	ns
			3.0 V to 3.6 V	1.6		15	ns
			4.5 V to 5.5 V	1.5		15	ns
t_{rB}	Input Rise Time	B-port rise time, push-pull driving	2.3 V to 2.7 V	1.7		15	ns
			3.0 V to 3.6 V	1.3		10	ns
			4.5 V to 5.5 V	0.9		10	ns
t_{fA}	Input Fall Time	A-port fall time, push-pull driving	2.3 V to 2.7 V	1.5		10	ns
			3.0 V to 3.6 V	1.2		10	ns
			4.5 V to 5.5 V	1.3		10	ns
t_{fB}	Input Fall Time	B-port fall time, push-pull driving	2.3 V to 2.7 V	1.4		10	ns
			3.0 V to 3.6 V	0.9		10	ns
			4.5 V to 5.5 V	0.7		10	ns
$t_{SK(O)}$	Skew (time), Output	Channel-to-channel skew, push-pull driving	2.3 V to 5.5 V			1	ns

8-bit Bidirectional Level Shifter, Push-Pull Mode

AC Timing Requirements — $V_{CCA} = 3.3\text{ V}$

All test conditions: $V_{CCA} = 3.0\text{ V}$ to 3.6 V , $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, unless otherwise noted.

The data is based on bench test and design simulation, not test in production.

Parameter		Condition	V_{CCB}	Min	Typ	Max	Unit
f_D	Data Rate	Push-pull mode	3.0 V to 3.6 V			90	Mbps
		Push-pull mode	4.5 V to 5.5 V			100	Mbps
t_W	Pulse Duration	Push-pull mode	3.0 V to 3.6 V	11.1			ns
		Push-pull mode	4.5 V to 5.5 V	10			ns
t_{PHL}	Propagation Delay (High-to-Low)	A-to-B, or B-to-A, push-pull driving	3.0 V to 3.6 V			20	ns
			4.5 V to 5.5 V			15	ns
t_{PLH}	Propagation Delay (Low-to-High)	A-to-B, or B-to-A, push-pull driving	3.0 V to 3.6 V			20	ns
			4.5 V to 5.5 V			15	ns
t_{en}	Enable Time	OE-to-A or B, push-pull driving	3.0 V to 5.5 V			100	ns
t_{dis}	Disable Time	OE-to-A or B, push-pull driving	3.0 V to 3.6 V			410	ns
t_{rA}	Input Rise Time	A-port rise time, push-pull driving	3.0 V to 3.6 V	2.1		15	ns
			4.5 V to 5.5 V	1.4		15	ns
t_{rB}	Input Rise Time	B-port rise time, push-pull driving	3.0 V to 3.6 V	2		15	ns
			4.5 V to 5.5 V	0.7		10	ns
t_{fA}	Input Fall Time	A-port fall time, push-pull driving	3.0 V to 3.6 V	1.4		10	ns
			4.5 V to 5.5 V	1.2		10	ns
t_{fB}	Input Fall Time	B-port fall time, push-pull driving	3.0 V to 3.6 V	1.3		10	ns
			4.5 V to 5.5 V	1.1		10	ns
$t_{SK(O)}$	Skew (time), Output	Channel-to-channel skew, push-pull driving	3.0 V to 5.5 V			1	ns

8-bit Bidirectional Level Shifter, Push-Pull Mode

Parameter Measurement Waveforms

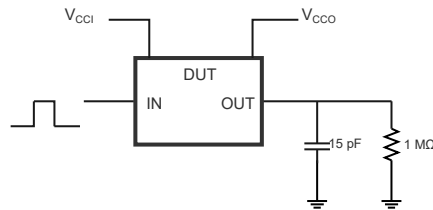


Figure 1. Timing Measurement Load Circuit of Push-Pull Driver

Test	S1
t_{PZL}/t_{PLZ}	$2 \times V_{CCO}$
t_{PHZ}/t_{PZH}	Open

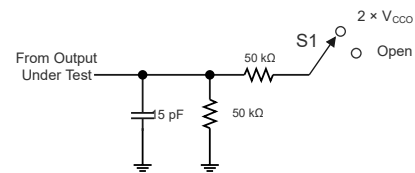


Figure 2. Load Circuit for Enable and Disable Time Measurement

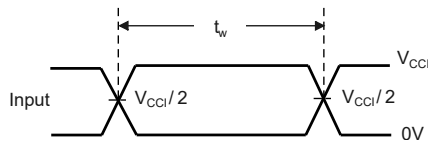


Figure 3. Pulse Duration

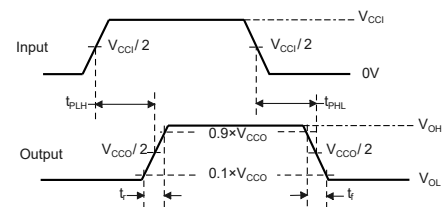


Figure 4. Propagation Delay Times

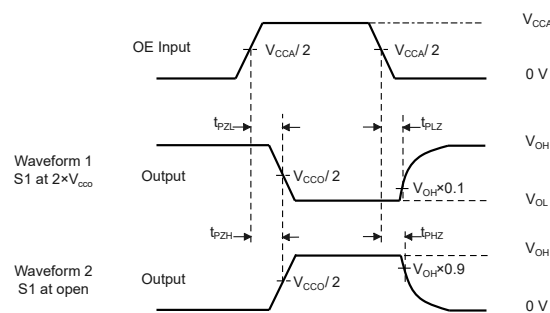


Figure 5. Enable and Disable Times

8-bit Bidirectional Level Shifter, Push-Pull Mode

Detailed Description

Overview

The TPT20208 device is an 8-bit level shifter, with an enable (OE) input and can work within the V_{CCA} range from 1.2 V to 3.6 V and the V_{CCB} range from 1.65 V to 5.5 V. V_{CCA} must be less than or equal to V_{CCB} . The TPT20208 supports bidirectional voltage translation among 1.2 V, 1.5 V, 1.8 V, 2.5 V, 3.3 V, and 5 V. The A1~8 I/Os are connected to the B1~8 I/Os, which allows bidirectional data flow between ports. If OE is low, the translator switch is off, and a high-impedance state exists between ports to isolate both sides. The OE input circuit is internally connected to V_{CCA} . 8-bit bidirectional buffer isolates capacitance and allows 15 pF on either side of the device to support 100 Mbps speeds in Push-Pull mode at 3.3 V V_{CCA} and 5 V V_{CCB} .

Functional Block Diagram

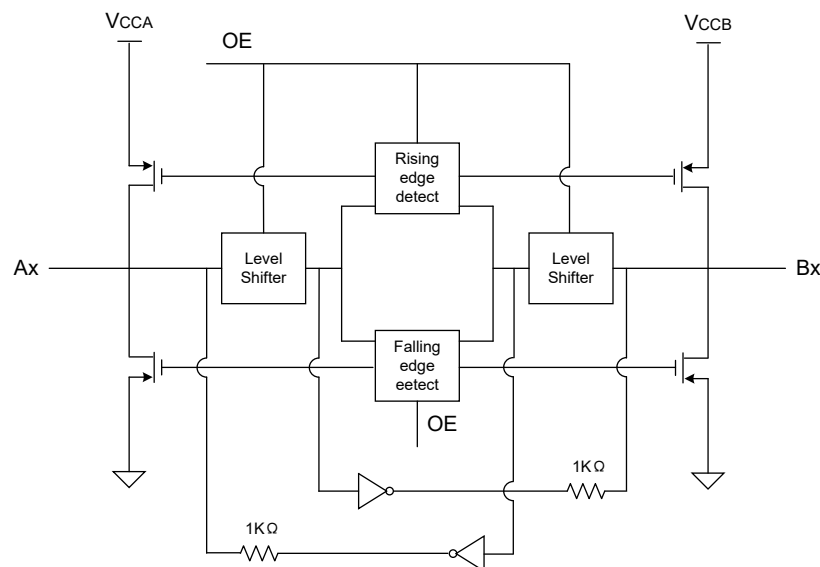


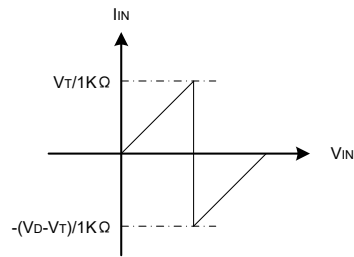
Figure 6. Functional Block Diagram

Feature Description

Input Driver Requirements

Typical I_{IN} vs V_{IN} characteristics of the TPT20208 are shown in [Figure 7](#). For proper operation, the device driving the data I/Os of the TPT20208 must have drive strength of at least ± 3 mA.

8-bit Bidirectional Level Shifter, Push-Pull Mode



V_T : input threshold voltage of the TPT20208 (typically $V_{CC}/2$).
 V_D : supply voltage of the external driver.

Figure 7. Typical I_{IN} vs V_{IN} Curve

Power Up

During operation, make sure that $V_{CCA} \leq V_{CCB}$ at all times. During power-up, even if $V_{CCA} \geq V_{CCB}$, it will not damage the device, so there is no power-on sequence requirement, any power supply can be ramped up first.

Enable (OE)

The OE pin is active-HIGH, with switching thresholds referenced to V_{CCA} . When driven LOW, OE disables the TPT20208 and places all I/Os in a high-impedance state. The t_{dis} parameter indicates the delay time between the OE pin going low and I/Os outputs entering the high-impedance state. Then Enable time ten indicates the period of time that the user operates the one-shot circuit after the OE pin goes high.

To ensure the high-impedance state during power-up or power-down, the OE pin should be connected to GND through a pull-down resistor; the minimum value of this resistor is determined by the driver's current-sourcing capability.

Table 2. Device Function Table

Input OE	Translator Function
H	$A_x = B_x$
L	A_x is disconnected to B_x , high-impedance

(1) The OE pin should be pulled up to V_{CCA} or pulled down to GND, it must not be left floating.

8-bit Bidirectional Level Shifter, Push-Pull Mode

Application and Implementation

Note

Information in the following application sections is not part of the 3PEAK's component specification and 3PEAK does not warrant its accuracy or completeness. 3PEAK's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

Application Information

The TPT20208 device is an 8-bit level shifter, with an enable (OE) input and can work within the V_{CCA} range from 1.2 V to 3.6 V and the V_{CCB} range from 1.65 V to 5.5 V. V_{CCA} must be less than or equal to V_{CCB} . The TPT20208 supports bidirectional voltage translation between 1.2 V, 1.5 V, 1.8 V, 2.5 V, 3.3 V, and 5 V. The A1~8 I/Os are connected to the B1~8 I/Os, which allows bidirectional data flow between ports. If OE is low, the translator switch is off, and a high-impedance state exists between ports to isolate both sides. The OE input circuit is internally connected to V_{CCA} .

- Servers/Storages
- Routers (Telecom Switching Equipment)
- Personal Computers/Consumer Handsets
- Industrial Automation

Typical Application

A typical application is shown in [Figure 8](#). The TPT20208 device can be used in level-translation applications for interfacing devices or systems operating at different interface voltages with one another. The TPT20208 device is ideal for use in applications where a push-pull driver is connected to the data I/Os.

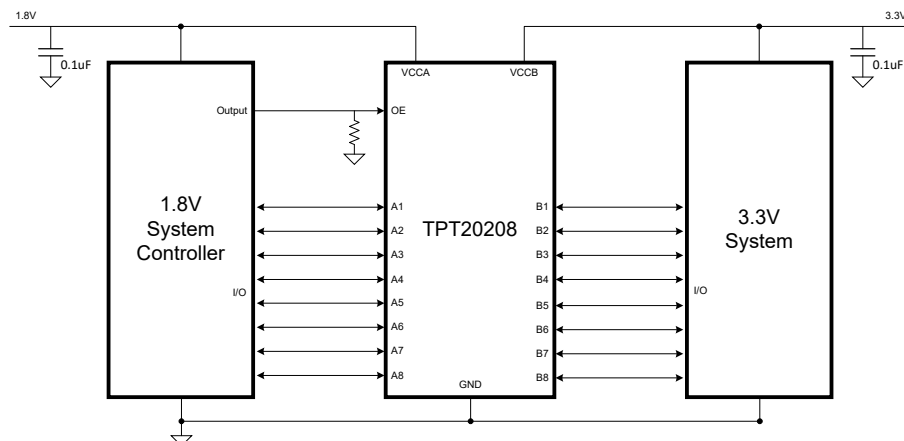


Figure 8. Typical Application Circuit

8-bit Bidirectional Level Shifter, Push-Pull Mode

Layout

Layout Example

Reflections and matching are closely related to loop antenna theory but different enough to warrant their own discussion. When a PCB trace turns a corner at a 90° angle, a reflection can occur. This is primarily due to the change in the width of the trace. At the apex of the turn, the trace width is increased to 1.414 times its width. This change in width upsets the transmission line characteristics, especially the distributed capacitance and self-inductance of the trace, thus resulting in the reflection. Not all PCB traces can be straight, so they have to turn corners. Below are progressively better techniques for rounding corners. Only the last example (BEST) maintains constant trace width and minimizes reflections.

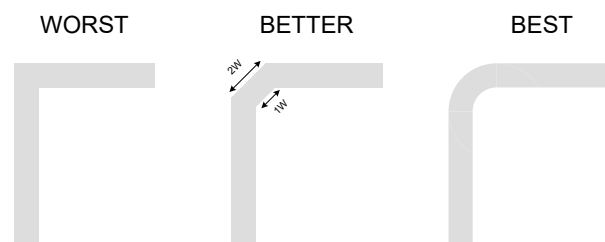


Figure 9. Trace Example

Route high-speed signals using a minimum of vias and corners which reduces signal reflections and impedance changes. When a via must be used, increase the clearance size around it to minimize its capacitance. Each via introduces discontinuities in the signal's transmission line and increases the chance of picking up interference from the other layers of the board. Be careful when designing test points, through-hole pins are not recommended at high frequencies.

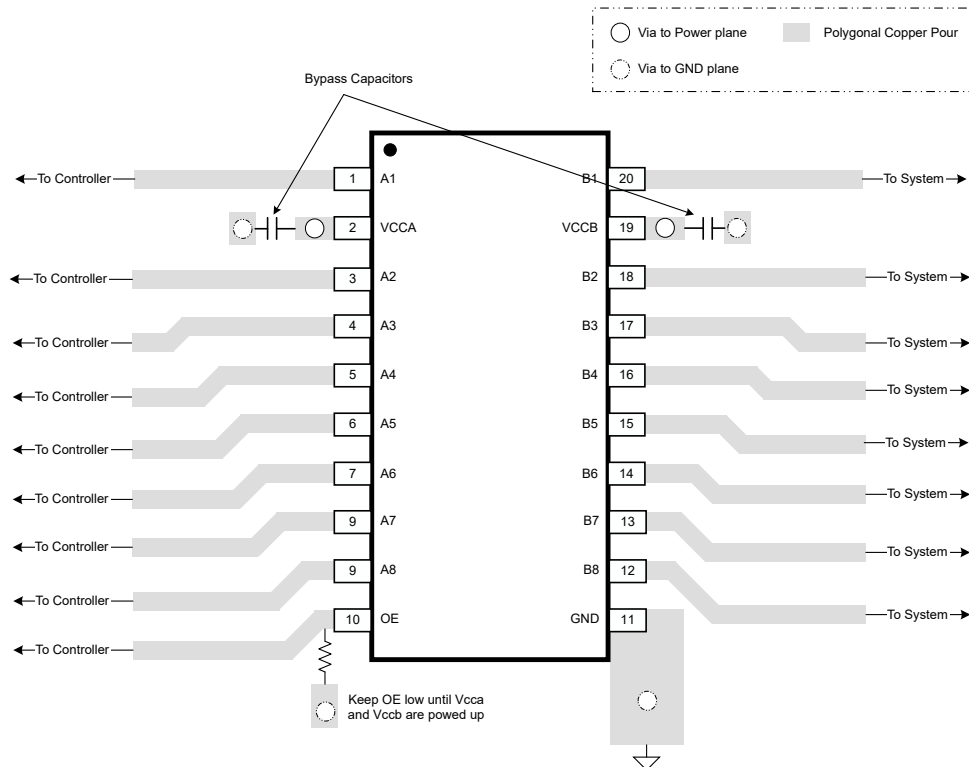
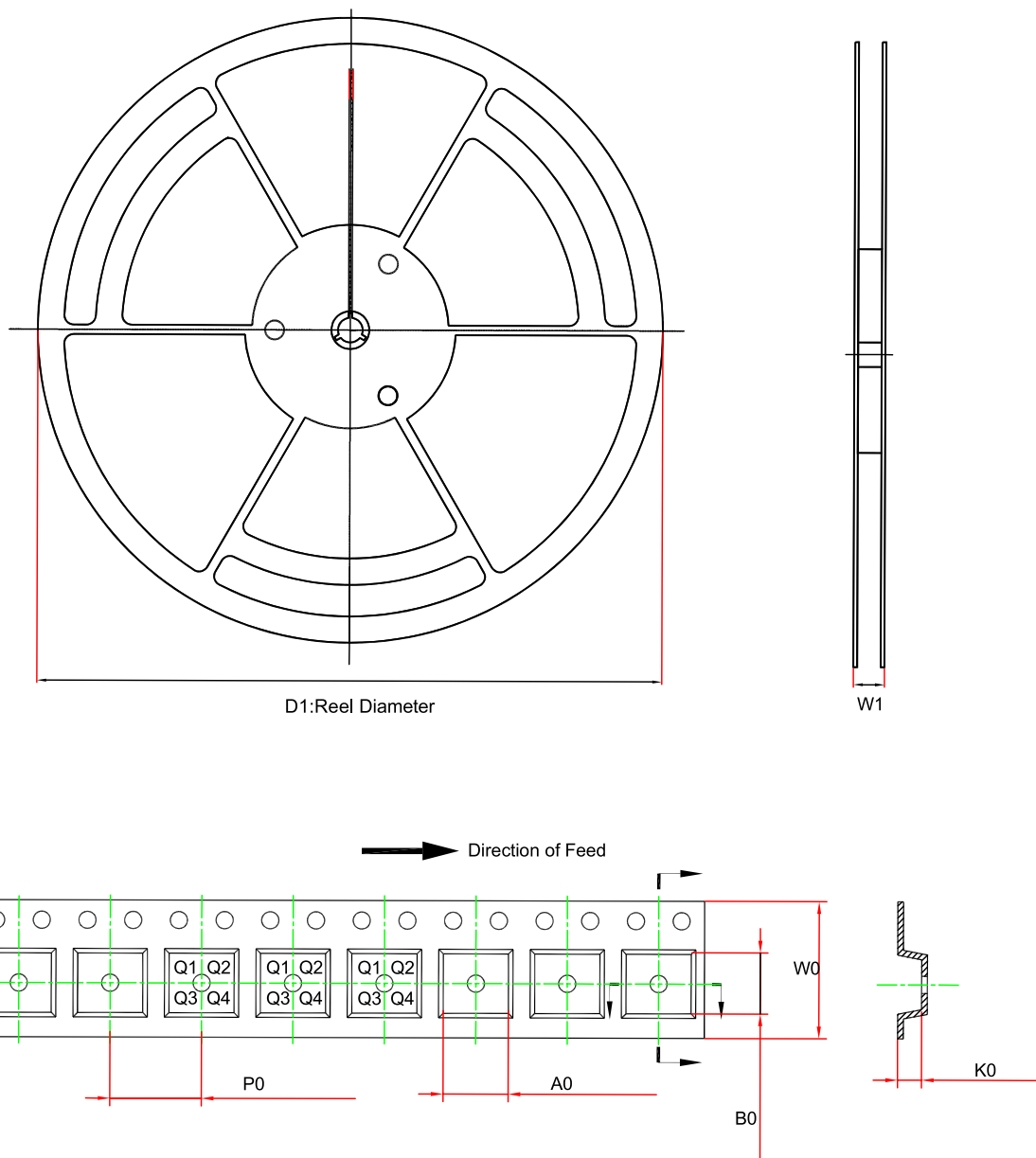


Figure 10. Layout Example

8-bit Bidirectional Level Shifter, Push-Pull Mode

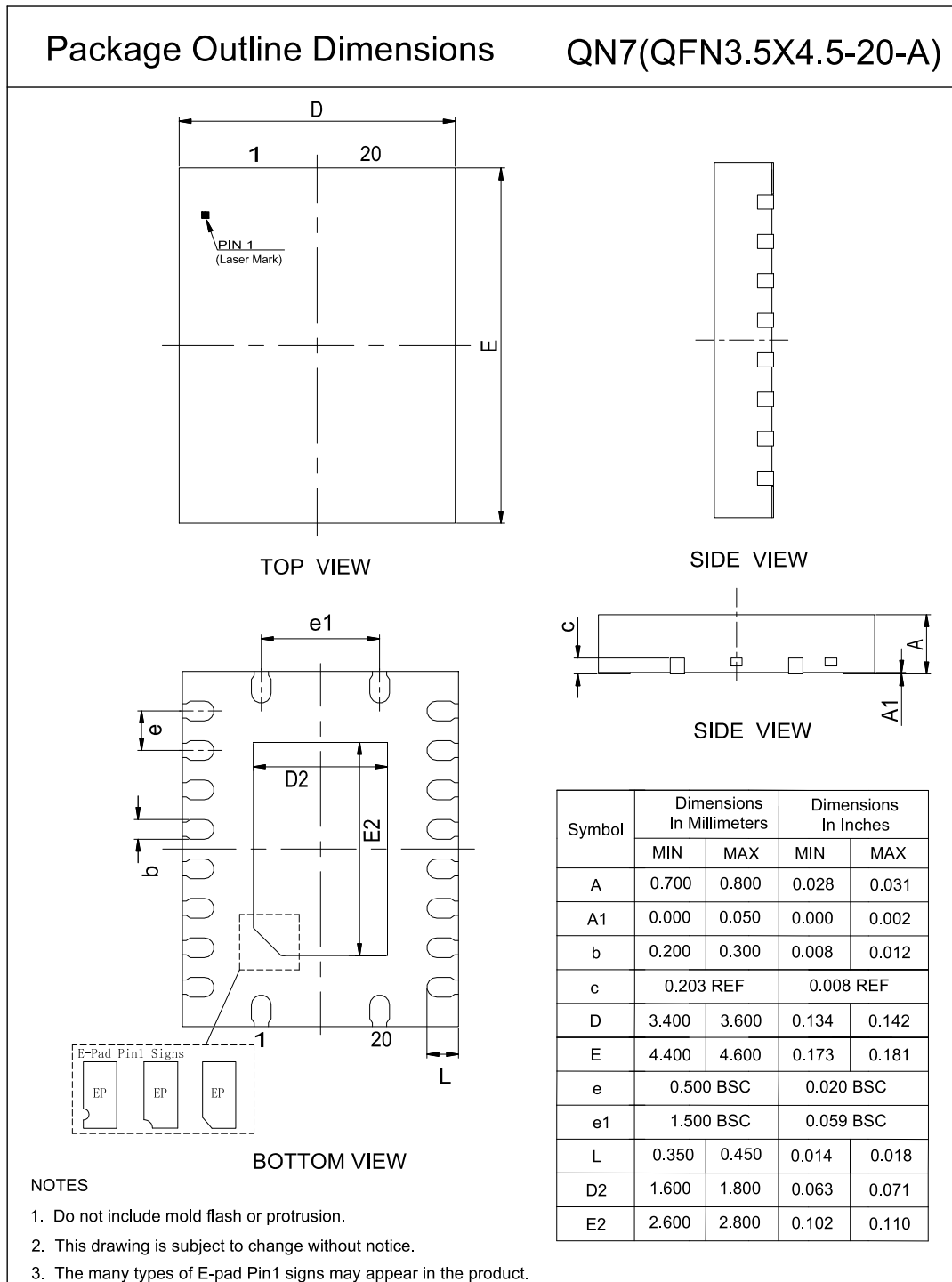
Tape and Reel Information

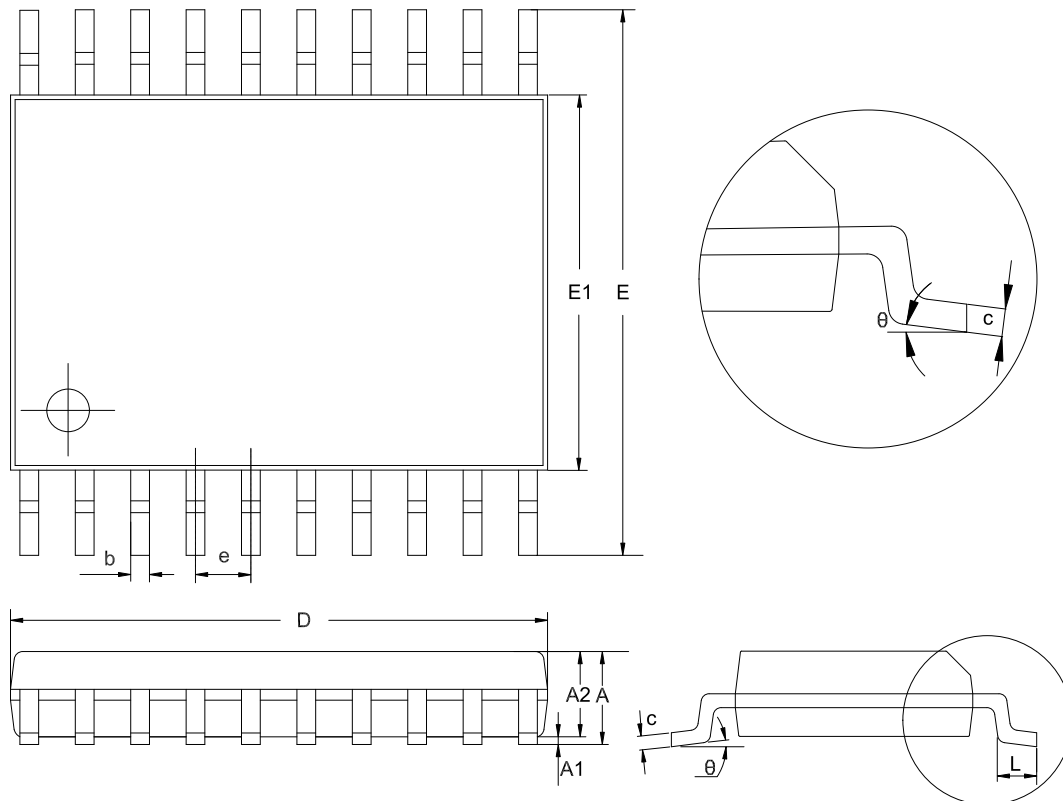


Order Number	Package	D1 (mm)	A0 (mm)	K0 (mm)	W0 (mm)	W1 (mm)	B0 (mm)	P0 (mm)	Pin1 Quadrant
TPT20208-QN7R	QFN3.5X4.5-20	329	3.8	1.18	12.0	17.6	4.8	8.0	Q1
TPT20208-TS4R	TSSOP-20	330	6.8	1.7	12.0	17.6	6.85	8.0	Q1

Package Outline Dimensions

QFN3.5X4.5-20



8-bit Bidirectional Level Shifter, Push-Pull Mode
TSSOP20
Package Outline Dimensions
TS4(TSSOP-20-A)


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.900	1.200	0.035	0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	6.400	6.600	0.252	0.260
E	6.200	6.600	0.244	0.260
E1	4.300	4.500	0.169	0.177
e	0.650 BSC		0.026 BSC	
L	0.450	0.750	0.018	0.030
θ	0	8°	0	8°

NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TPT20208-QN7R	-40 to 125°C	QFN3.5X4.5-20	20208	MSL2	Tape and Reel, 3000	Green
TPT20208-TS4R	-40 to 125°C	TSSOP-20	20208	MSL3	Tape and Reel, 4000	Green

Green: 3PEAK defines "Green" to mean RoHS compatible and free of halogen substances.

IMPORTANT NOTICE AND DISCLAIMER

Copyright© 3PEAK 2012-2026. All rights reserved.

Trademarks. Any of the 思瑞浦 or 3PEAK trade names, trademarks, graphic marks, and domain names contained in this document /material are the property of 3PEAK. You may NOT reproduce, modify, publish, transmit or distribute any Trademark without the prior written consent of 3PEAK.

Performance Information. Performance tests or performance range contained in this document/material are either results of design simulation or actual tests conducted under designated testing environment. Any variation in testing environment or simulation environment, including but not limited to testing method, testing process or testing temperature, may affect actual performance of the product.

Disclaimer. 3PEAK provides technical and reliability data (including data sheets), design resources (including reference designs), application or other design recommendations, networking tools, security information and other resources "As Is". 3PEAK makes no warranty as to the absence of defects, and makes no warranties of any kind, express or implied, including without limitation, implied warranties as to merchantability, fitness for a particular purpose or non-infringement of any third-party's intellectual property rights. Unless otherwise specified in writing, products supplied by 3PEAK are not designed to be used in any life-threatening scenarios, including critical medical applications, automotive safety-critical systems, aviation, aerospace, or any situations where failure could result in bodily harm, loss of life, or significant property damage. 3PEAK disclaims all liability for any such unauthorized use.

This page intentionally left blank